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REDUCING SWITCHBOARD LOSSES.

In a well-designed power plant the amount of electrical energy lost in switchboard equipment and fittings should be so small as to cause no trouble from heating and should be but a trifling percentage of the total wattage transmitted through the board from the generators to the outgoing lines. Trouble sometimes develops, however, after a plant has been in operation for a considerable time, or in new installations which have been hurried to completion on account of the necessity of securing service at the earliest possible date. Loose contacts or improperly fitted surfaces, roughened switch blades or burned laminations are responsible for most cases of switchboard overheating. Where large currents are handled through the board it is desirable to pay special and regular attention to the condition of the contact bolts, studs, and nuts of bus bars, circuit breakers, switches and instrument shunts, as the existence of bad connections means avoidable losses carried back to the coal pile and often injury to the appearance of the board and perhaps interference with the accuracy of instrument readings through reduced current flow or overheating.

To wait until a poor contact announces its presence by sensible heating is inadvisable, since a simple test with a millivoltmeter is all that is necessary to indicate the condition of most fittings. In plants operating at potentials ranging between 125 and 600 volts the volume of current handled is usually sufficient to produce appreciable drops across terminals on the rear or front of the panels. A connection in very poor condition will usually indicate the fact by excessive heating, but if the load fluctuates through a wide range the contact may remain bad for many weeks without disclosure through its temperature rise, or again, it may be difficult to determine by the sensible heating which one of a group of closely associated contacts happens to be at fault, since the heat developed in the worst contact is readily transmitted to the others and dissipated from a multiplied surface area. With a millivoltmeter in hand the problem is greatly simplified.

The drop around a good contact in a circuit breaker of five or six thousand amperes capacity may run from seven to eight millivolts, for example, measuring from the laminated contact to the stud plate, while with a poor contact the reading may easily show a drop of from 75 to 120 millivolts. With the permanent contacts behind the breaker

in good condition, the drop should not exceed three or four millivolts, on the average, and about double this drop could be expected around the contacts of the laminated main switch in series with the breaker. Dirty contacts or loose connections not only cause excessive heating, but the actual energy loss at a single breaker may cost $30 or $40 per year, and on a large board where a considerable number of contacts may be in poor condition it is not unusual to find that the cost of the energy wasted in excessive heat amounts to $500 or $600 a year.

Care in the initial installation of all studs, blades, clips, shunts and other connections will repay the time and trouble necessary to insure the plant against heating difficulties. Under conditions of severe or long-continued vibration and particularly around heavy switches or other apparatus subjected to shocks, special attention is desirable at the nuts and contact surfaces. Laminated contacts in particular need to be kept clean and to a plane surface. There is little excuse for careless and hasty adjustment of contacts after repairs or during the construction of the plant, including the omission of some of the multiple straps in shunt connectors, failure to screw nuts tightly home or the injury of threads by lack of cleaning. The practice of keeping circuit breakers closed when switches in series with them are open is also helpful in the maintenance of good conditions at the laminated contacts.

ELECTRICITY AND THE CONSERVATION OF PUBLIC HEALTH.

In these days of agitation for the conservation of our natural resources attention might well be directed to a matter of vital interest to the country as a whole and to each separate individual. This is the conservation of the public health. There is no asset of greater value to a people than a sound and robust state of health. As the vigor of an individual is lost when his health is undermined, so the decadence of many nations has been caused by unhygienic living.

Owing to the rapid growth in size and number of our cities the effect of city life upon public health is a question of considerable importance. In 1790 the percentage of the population of the United States that lived in cities was 3.3. By 1850 it had risen to 12.5 per cent. The census of 1900 showed 33.1 per cent urban population. The present census will probably disclose the percentage to be nearly 40. Without discussing the economic and social causes that are bringing about this progressive urbanization, it must be admitted that they are so strong that this movement is not likely to stop for some time. Therefore the problems of city life are constantly demanding greater attention.

There is a prevailing opinion among many of our well-informed public men that this urbanization bodes ill to the nation. Our illustrious ex-president, Colonel Roosevelt, has said: "The men and women on the farms stand for what is fundamentally best and most needed in our American life. Upon the development of country life rests ultimately our ability to supply the city with fresh blood, clean bodies and clear brains that can endure the terrible strains of modern life; we need the development of men in the open country, who will be in the future, as in the past, the stay and strength of the nation in time of war, and its guiding and controlling spirit in time of peace."

That the alleged unwholesomeness of city life is open to question is clearly set forth in an article on "Constructive Community Hygiene," by Dr. L. H. Gulick in a recent issue of *Science*. The fact that the urban death rate is falling more rapidly than the rural death rate should allay much of the fear of a possible dismal future. In many ways city life is more healthful than country life. Sanitary engineering has provided for most of our cities water supply and drainage systems that are far more wholesome than what is commonly found in the country. There are comparatively few farms that have such a varied food supply as is available in our cities.

However, whether we grant that country life is much more healthful than city life or not, it must be conceded that there are present in the city many features that directly result in a lowered resistance to disease and in the long run are bound to affect the vitality of the people. Among these unwholesome elements of city life are smoke, dust, dirt, crowded tenements and general lack of pure air. Even though there be developed in us a gradual immunity from infection from these sources, it is most desirable to remove the causes of possible danger, especially when by doing so the vigor of the race and the joy of living will be vastly increased. As an instance of the great need of preventive measures it may be noted that many medical authorities contend that over ninety per cent of the human race becomes infected at some period of life with tubercle bacilli; in most instances these bacteria remain dormant or passive, but that the great stress of modern life, along with unhygienic living, particularly in cities, renders them all too frequently virulent and active again is attested by the great prevalence of the white plague. It is well, therefore, that the modern physician is interested not only in conserving our present state of health but in actively preventing disease and promoting a higher standard of living.

It is in this service that electricity has lent its aid and it stands ready in almost innumerable ways to add to the well-being and comfort of the individual and of the public as a whole.

One of the imperative needs of every city is the elimination of the smoke nuisance. Of the various measures proposed none is so comprehensive, and withal so thoroughly effective, as the concentration of all power, light and heat supply for the entire community in one or a few central stations. Regarding the first of these utilities, much headway has already been attained in the general use of electricity for power purposes, its cleanliness and convenience alone

being sufficient reasons for its adoption in a large number of instances. When to these is added in increasing degree economy in operating and maintenance costs, along with economy of space, etc., the elimination of the isolated power plant might even be ordered by the police powers of the community, because there is left no reason why the superior service of the central station with its entire absence of public nuisance should not replace it. As a community builds up and its factories and industries multiply, it is readily conceivable that the noxious gases belched forth from a multitude of chimneys alone become a public nuisance, even if dense smoke and soot be assumed to be absent. Among the worst offenders in the smoke nuisance of our cities are the present steam railroads. Electrification of their terminals is the only means by which the nuisances of their fuel-burning locomotives can be completely eliminated. It is not only feasible but economical and the public health alone may make it imperative.

About the only reason still advanced in favor of isolated plants in our cities is the need of heat supply. Although electricity has not yet been much used for the heating of buildings on a large scale, the marked development of district heating, particularly in connection with electric central stations, removes the last excuse for the isolated plant. It is even conceivable that the public demand for pure air will compel the exclusive employment of centrally developed heat for heating our residences and apartments, although ultimately electricity may be used as successfully for this service as it is for cooking, ironing, etc.

The hygienic value of electricity for lighting is well known to all. Its freedom from vitiation of the air should make its use in confined places imperative, and moreover it is cleaner and does not heat the air.

For the propulsion of our street cars electricity is now universally used. As the density of street traffic increases urban transportation is forced to seek elevated or subway lines. Electricity is used exclusively on these systems, in fact, without it the subway lines would be a serious menace to the public health. The increasing use of the automobile is reducing the nuisances attendant on the employment of horses on the streets. Of the three types of automobiles, gasoline, steam and electric, the latter is the least obnoxious.

The sanitary removal of dust in our homes has been materially aided by the use of vacuum cleaners, whose extensive employment has been made possible by electricity. It is becoming very common for owners of apartments to equip them with vacuum cleaning systems for the use of the tenants. The use of the electric fan is a material aid in improving the ventilation of apartments. In these and other ways the objections to people living in close quarters are being reduced by electric service. On the other hand, the perfection of electrical means of urban transportation has enabled more people to live in the suburbs and less densely inhabited parts of our cities.

In this hasty review of the ways in which electricity promotes healthful living, no mention has been made of its numerous applications in medicine and surgery, the attention being directed rather to its use in preventing disease than curing it. The general use of electricity, particularly in our cities, along the lines referred to and others, is becoming one of the most noteworthy means for preventing disease, and therefore of conserving the public health.

THE VITAL SPARK.

The electric current has invaded so many phases of modern life that we are quite accustomed to take it as a matter of course in the commonplace affairs of life and hardly realize sometimes that it is an important, or even an essential, agency in the conduct of these affairs. Where electric power is used for lighting, traction, driving machinery, or for operating telegraph or telephone lines, it occupies the position of prominence and the apparatus is recognized as depending upon the action of the electric current. There are many other activities, however, in which the electric current is not the prominent or predominating element, and yet in which its application is quite as necessary and potent as in the others mentioned.

One of the best illustrations of this is to be found in the gasoline engine. When the motorist or the aerial navigator is seen flying over the surface of the earth or through the air, it is the build of the machine, the arrangement of the parts, or the shape and number of the planes which is likely to attract attention. The ordinary observer little thinks that one of the essential requirements for the operation of the motor is furnished by the electric current.

The gasoline engine has come to be very widely used, and when the alcohol motor is perfected we may expect its application, as successor to the gasoline-driven machine of the present day, to be even more widely extended. Not only do automobiles, motor-boats, dirigibles and aeroplanes make almost exclusive use of this motor, but in many stationary installations, such as pumping engines, it is also to be found. The steamboat was the predecessor of the naphtha launch, and the locomobile has been a competitor of the automobile, but in the field of aerial navigation the explosion motor, dependent upon the electric spark, is alone in the field.

All the energy which has been devoted to experimentation and study, to the designing of the motor giving the greatest power with the least weight, to determining the proper size, shape and location of the surfaces which support and guide these vehicles of the air, would be futile without the vital spark which releases the pent-up power utilized for propulsion. If the spark coil fails or the electric circuit becomes broken, disaster follows. Although only an accessory of the fundamental machine, the electric energy which is used to control the greater energy liberated by the explosion of the vapor is as essential to the operation of the whole as is the vapor itself.

American Society of Heating and Ventilating Engineers Holds Semi-annual Convention.

The semi-annual convention of the American Society of Heating and Ventilating Engineers met at the American Hotel, St. Louis, on the morning of Thursday, June 30, and adjourned on the afternoon of Friday, July 1. The total attendance was 115.

The meetings were held in the auditorium of the American Theater. President James D. Hoffman presided throughout the session and Secretary Wm. M. Mackay was in attendance at all meetings.

The society was welcomed to the city by Edgard R. Raumbauer, Speaker of the House of Delegates, who represented Mayor Kreismann, who was not able to be present.

After President Hoffman's address and the reading of various communications by the secretary and the reports of the different committees the following topics of discussion were taken up: "The Function of the Society and Its Achievements;" "The Relative Merit in Efficiency and Sanitary Effect of Furnace-Heated Air, and Air Heated by Steam or Hot Water Radiators."

Thomas Morrin, of San Francisco, opened the discussion of the latter topic. This theme was also discussed by Prof. J. H. Kinealy, of St. Louis; Samuel R. Lewis, of Chicago; Theodore Weinshank, of Indianapolis; Wm. H. Bryan, of St. Louis, and several others.

At the Thursday afternoon session a paper was presented by Nelson S. Thompson, of the Supervising Architect's office, Washingtion, D. C., on "Heating and Ventilation of Federal Buildings." This paper covered the author's practice in designing heating and ventilating plants in the buildings designed by the office of the Supervising Architect, and gave a great deal of valuable data concerning the methods employed. Tables were given showing the heat transmission through walls of various materials and different thicknesses; also tables of sizes of piping employed for different systems. The author also gave the methods employed for determining the sizes of cast-iron boilers, steel boilers, and water-tube boilers when using different kinds of fuel from the best anthracite to the cheapest bituminous coal, including also natural-gas fuel.

The other topics for discussion at the Thursday afternoon session were: "Appreciation of the Heating and Ventilating Engineer;" "The Science of Acoustics and Its Relation to Heating and Ventilating;" "The Proper Size of Mains, Risers and Connections in a Forced Circulation of Hot-Water Heating from a Central Plant;" "The Use and Reliability of Automatic Air Valves on the Radiators of a Hot-Water System Supplied by Forced Circulation from a Central Plant."

At the Friday morning session a paper was presented by L. C. Soule, of the American Radiator Company, covering a series of tests on cast-iron hot-blast heaters at Buffalo, N. Y., during the past winter.

This paper is notable as being the publication for the benefit of the profession at large of valuable engineering data obtained by an engineer in the employ of a manufacturing company made entirely at its expense and for its individual use.

The following topics for discussion were also taken up and disposed of during the morning session which was prolonged into the afternoon: "The Air Washer as a Means of Humidifying the Air for Ventilation;" "The Desirability of Cast or Malleable Nipples in Radiators;" "The Advantages of a Water Softener in Large Systems of Hot-Water Heating;" "The Duty of the Members to the Society;" "Safeguarding the Profession;" "Endowments for the Society to Further Its Work in the Interest of the Public."

In the afternoon the local entertainment committee (J. H. Kinealy, chairman) took the visitors in charge for an automobile ride throughout the residence districts and other points of interest in the city.

On Thursday evening a dinner was held at the American Hotel, with James D. Hoffman as toastmaster.

Southern Power Company Buys a New Plant.

The Southern Power Company, of Charlotte, N. C., which already owned four hydroelectric power plants developing approximately 100,000 horsepower of electricity and furnishing power for the operation of about fifty cotton mills and other enterprises, has purchased the Greenville-Carolina Power Company at Greneville, S. C., taking over the $250,000 of common stock and assuming the responsibility for $200,000 of preferred stock and $300,000 in bonds. The properties of the company taken over consist of a hydroelectric power plant on the Saluda River, six miles from Greenville, that develops about 6,000 horsepower of electricity, together with transmission lines and other equipment.

The Greenville-Carolina Power Company has been reorganized as a subsidiary company of the Southern Power Company.

Metropolitan Railway Sale.

Justice Lacombe in the United States Circuit Court for the Southern District has handed down an order postponing the sale of the Metropolitan Railway, of New York City, from July 1 to September 27, 1910, without prejudice to the right of petitioners to apply hereafter upon good cause for further adjournment.

The adjournment was taken upon a joint petition of Alexander T. Hemphill and others, constituting a bondholders' committee representing the general and collateral trust mortgage five-per-cent bonds of the Metropolitan Railway deposited under agreement of March 5, 1908, and Edwin S. Marston and others, constituting a bondholders' committee representing the four-per-cent refunding bonds deposited under agreement of November 25, 1907, and G. E. Tripp and others, constituting the joint reorganization committee.

Electric Smelting of Pig Iron.

Electric smelting of pig iron is proving practicable and economical in Sweden. Experiments show that it requires about 2,000 kilowatt-hours to produce pig iron from crude ore, another 1,000 kilowatt-hours being necessary to make pure steel, which, being of better quality, commands better prices and also enables the use of lower grade ores than is possible with other processes. The coke consumption averages .3 ton per ton of pig iron.

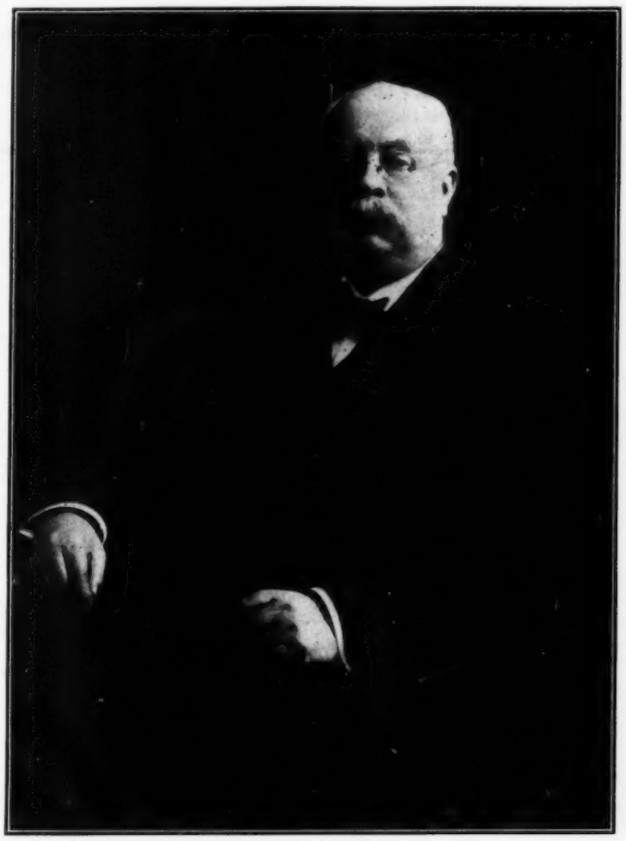
Kinloch-Postal Telephone Alliance.

According to a recent dispatch from St. Louis the Kinloch Telephone Company, of that city, will form a traffic alliance with the Postal Telegraph Company. The territory affected by this alliance will include Illinois, Indiana, Iowa, Missouri, Kansas, Kentucky and Ohio.

Ralph W. Pope.

The convention of the American Institute of Electrical Engineers which was held at Jefferson, N. H., last week, calls to mind a notable figure in the electrical industry. The American Institute of Electrical Engineers was organized in 1884. In 1885, Ralph Wainright Pope was made its secretary. From that time to the present time, he has seen the Institute grow from a small but enthusiastic community to an organization of large numbers, great influence and worldwide opportunity.

Mr. Pope was born at Great Barrington, Mass., August 16, 1844. He received a good common-school education in Great Barrington and at Amherst, Mass., and in 1858 had mastered the operation of the Hughes printing telegraph. In 1859 he entered the employ of the Housatonic Railroad, and in 1861 was appointed operator in charge of the Morse telegraph office at Great Barrington. He was, in 1862 and 1863, in the service of the American Telegraph Company in its New York, New Haven, and Providence offices, and in 1865 went to British Columbia with an exploring expedition for the Collins Overland Telegraph. He was appointed quartermaster at Quesnelles, where he remained until 1865, when he returned to the East and was appointed agent for the Housatonic Railroad at Pittsfield, Mass.



RALPH W. POPE,
Secretary of the American Institute of Electrical Engineers.

In 1867, he went into the employ of the Bankers' and Brokers' Telegraph Company, where he remained until 1872, when he became inspector for the Gold and Stock Telegraph Company. He was promoted to the position of deputy superintendent in 1880, and in 1882 became the business manager of the Union Electric Manufacturing Company of New York. In 1884 he was associate editor of the *Electrician and Electrical Engineer.* A year later he was elected secretary of the American Institute of Electrical Engineers, and in 1890 he founded *Electric Power.*

In 1891, he became editor for electrical terms in the "Standard Dictionary," and in 1893 he had charge of the rooms of the American Institute of Electrical Engineers in the Electrical Building, at the Columbian Exposition. He was appointed on the committee of judges for the department of electricity, and since that time has devoted himself entirely to the affairs of the American Institute of Electrical Engineers, with occasional literary work.

Mr. Pope is one of the most widely-known and cordially-esteemed men in electrical organization work. His early association with the men who have made famous names for themselves, his journalistic training, and his rugged and unfaltering honesty, have brought to him a great circle of friends and acquaintances. His tactful administration of Institute affairs has won him high commendation time and again, and recently he has been the special commissioner of President Stillwell to visit the geographical and branch sections of the Institute in order that these outlying adhesions may have a better idea of the scope and purposes of the Institute. In this, as in other things, Mr. Pope has been a notable success.

Brooklyn Edison Employees May Share Profits.

According to a statement recently made by W. W. Freeman, general manager of the Edison Electric Illuminating Company, in Brooklyn, N. Y., that company will share the profits of the business with its employees.

Mr. Freeman in discussing the scheme, said in part:

"A system will probably be arranged in some way so that the labor of the employees will be considered in appropriating dividends just as the capital of the stockholders is now. At the present time the Pennsylvania Railroad has about the largest and best known system of profit sharing, but the Edison company intends not to copy from any other system but to originate an entirely new one. It will probably take all of six months to get our ideas and theories worked out into practical shape. It is also probable that something will be done along the line of old age pensions in the near future."

Two New York Bills Signed.

Governor Hughes has signed the Parker bill, which gives greater power to the Public Service Commission of the First District, located in New York city. The Commission is given power to regulate its own rate of fare and has additional authority over the issuance of transfers in New York City.

The Governor has also signed Assemblyman A. E. Smith's bill, fixing the price of electricity in New York City at $160 a lamp per year for the flaming arc lamps.

The bill providing for the operation of the Steinway Belmont tunnel in New York city, so as to provide rapid transit facilities from the boroughs of Manhattan to Queens, has also received executive approval. The new law permits the transfer of the tunnel property with the consent of the Mayor of New York and the New York Public Service Commission, under a fifty year franchise to be granted by the New York Board of Estimate and Apportionment.

New York Street Railway Convention.

The annual meeting of the Street Railway Association of the State of New York was held at Cooperstown, N. Y., on June 28 and June 29. The only papers of electrical interest were those by T. W. Williams, of the General Electric Company, on "Railway Motor Gears and Pinions,' and by Clarence Renshaw, of the Westinghouse Electric and Manufacturing Company, on "Recent Developments in Multiple Unit Control and Other Electric Railway Apparatus."

Mr. Williams first discussed the causes for gear and pinion wear and then gave some figures showing the superiority of treated gears which had been heated and then quenched in some liquid, preferably oil. The author had found that heavy lubricants such as those containing pitch were best for prolonging gear and pinion life. Their value was not principally for lubrication but by forming a cushion on the teeth they prevented the grinding metal-to-metal contact.

Mr. Renshaw's paper dealt with the new Westinghouse type HL unit-switch control apparatus which makes possible the installation of a simplified multiple unit system for city and suburban surface cars. One important difference from the previous electropneumatic equipments for train operation is that the new apparatus is not arranged for automatic acceleration. In the type HL equipments the various main-circuit connections between the trolley, resistance and motors, are made by six or eight unit switches, each provided with a magnetic blowout and normally held open by a spring. These switches are assembled in a frame designated as a "switch group." In larger sizes, the group is supplemented by two additional switches mounted in a second frame, and called a "line switch." Each switch is closed when desired by compressed air acting on a piston, which opposes the spring and forces the lower or movable switch jaw against the upper or stationary one. The reverse drum is pneumatically operated and mounted in a separate case. The operation of the switches and reverser is regulated by electrically operated magnet valves attached to air cylinders and governed by a master controller. The small amount of power required for operating the magnet valves is taken from the trolley through a resistance. The circuits from the master controller are taken to a twelve-conductor train line from which branch circuits are run to each piece of apparatus. Air for operating the pneumatic parts is obtained from the air-brake system through strainers for removing the moisture and through a reducing valve set for seventy pounds pressure. An emergency reservoir is provided in case the air-brake system should fail. A particular feature of the control for quadruple equipments is the arrangement of the cut-out switches for cutting out a damaged motor when necessary. In case of trouble, one motor of each pair is cut out, thus leaving the remianing two motors operated in series-parallel just as if they were the two motors of a double-motor equipment.

A paper of more general interest was that by Henry W. Blake, editor of the *Electric Railway Journal*, on the "Problem of the Five-Cent Fare," in which the present fare unit is held to be inadequate mainly on account of the increased length of ride, the issue of free transfers, the increased cost of operation per passenger and the increased interest rate on capital for betterments and extensions. The substitution of four-motor for two-motor equipments was one of the large elements in the increased cost of cars. It was the general opinion of the convention delegates that relief would be afforded to the railway companies if they were permitted to charge, say, one cent each for transfers.

A feature of the banquet on June 29 was an address by John N. Carlisle, member of the New York Public Service Commission, District No. 2, embracing all of New York State except New York City. After referring to the necessity of having regulation of public service corporations, Mr. Carlisle pointed out that the utilities companies of the State had a wrong idea of its functions. The Commission existed for other purposes than to listen to complaints from the public; it also existed for the purpose of seeing that the public-service corporations were not unduly harrassed by onerous local franchise requirements, taxes and regulations. In several instances, corporations which had appealed to the Commission had been strongly assisted upon their showing that they wished to give the public the best possible service permitted by conditions. In one case, the Commission had refused to approve a project because it felt convinced that the local municipality's exactions were too great to permit the company to do business profitably. It was a mistake to suppose that the Commission wanted to restrict corporation profits to any such figure as six per cent. On the contrary, it would be pleased to see the public-service companies make twenty-five per cent on their common stock if at the same time they were giving good service. The financial condition of the New York public-service bodies was a most serious one. Thus of the 310 gas, electric and street railway companies in the Commission's jurisdiction, 237 or eighty per cent, were not paying dividends on any kind of preferred or common stock. The capitalization of the non-dividend companies totaled $142,330,000, or sixty-six per cent of all the common and capital stock issued by these corporations. Either there was too much stock or an insufficient return was being secured upon it. However, the Commission realized that the present managers were not responsible for the over-capitalization of the past. If money were needed for new work, it was perfectly willing to make a reasonable allowance for the inevitable promotion and organization expenses over the actual construction cost. The Commission was anxious to see that the corporations got enough money to run their business but it would not countenance the capital inflation of the past. Mr. Carlisle's remarks made a deep impression and met with approval.

The following officers and executive committee were elected for the ensuing year: President, James H. Pardee, operating manager, J. G. White & Company, New York; first vice-president, E. J. Cook, general manager, New York State Railways, Rochester; second vice-president, J. W. Hinkley, Jr., president Poughkeepsie City & Wappingers Falls Railway; secretary, C. Gordon Reel, Kingston; treasurer, H. M. Beardsley, assistant general manager, Elmira Water, Light and Railroad Company; executive committee, J. K. Choate, W. H. Collins, J. C. Calisch and J. E. Duffy.

Automatic Railway Safety Device.

Consul Homer M. Byington, of Bristol, England, sends a British press account of a new railway device for giving automatic warnings to engineers of danger signals set against them, which is filed for public reference in the Bureau of Manufactures, Washington, D. C.

Electricity Supply in Dundee, Scotland.—II.

An Illustrated Account of the New High-Tension System.

BY ROBERT L. REID.

The alternators are of the Dick Kerr three-phase type, giving current at 6,600 volts, fifty cycles, when running at a speed of 1,500 revolutions per minute. The rotor, which is very strongly constructed, has four separate radial poles with laminated pole-shoes, and each pole carries its own field coil. The stator frame is in one piece and is also very strongly constructed, having the winding imbedded in slots and carefully insulated. The stator is arranged to slide lengthways along the shaft on the bedplate to give access to the rotor and allow for inspection. The end shields are of the close type and close down almost on to the main shaft. The fan action of the rotor therefore draws cold air from ventilating passages which have been left below and discharges it through the openings left in the stator. The close type of end shield keeps out a great deal of dust which would otherwise be drawn in, in addition to reducing the noise while running. Direct-coupled to each alternator is a four-pole exciter of 18.5 kilowatts at 125 volts.

INTERIOR OF CLEPINGTON SUBSTATION.

CONDENSING PLANT.

Underneath each turbine and bolted to the exhaust flange is a Contraflo surface condenser of 3,400 square feet cooling surface. To take up expansion and prevent distortion of the turbine body the condenser is made to rest on springs and is not otherwise fixed. Each condenser has 2,173 tubes three-quarters of an inch diameter by eight feet long. The condenser and tubes are protected from pitting by a patent arrangement in which blocks of a metal electro-positive to the brass and iron are fixed to the tube plates. There is an automatic atmospheric valve above each condenser, with an eighteen-inch exhaust pipe leading to the atmosphere.

A three-throw Edwards air pump is provided for each set, driven by means of gearing from an electric motor. A force pump at the end of the air-pump crankshaft lifts the discharge to a Lea recording water meter on the upper floor, where, after being measured, it gravitates to the hot wells. In this type of water meter the water is made to flow over a V-notch and the height of water flowing over the notch is recorded by a plunger and float; thus a constant record of the steam taken by the turbine is obtained. The hot wells

are situated on the lower engine room floor, have each a capacity of 8,500 gallons and are made of steel plates a quarter of an inch thick, stiffened and stayed by angles. In a conspicuous place, easily seen from the upper floor, a float and weight indicator gives the levels of the water in the hot wells.

CIRCULATING WATER.

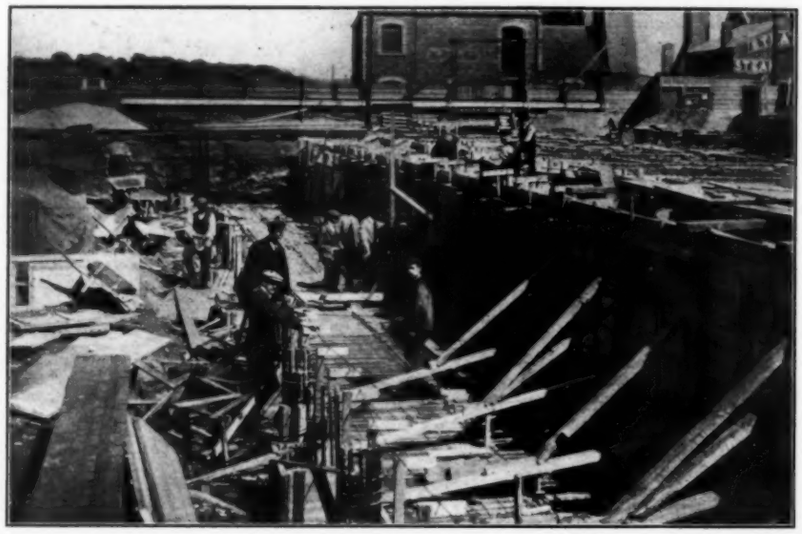
As previously mentioned the circulating water for the condensers is obtained from the River Tay. There is a maximum rise and fall of the tide in the river equal to eighteen feet, and the top of the condensers is 28.5 feet above the lowest water level. In order to reduce the power required to circulate the large amount of water required over this height, and also to avoid the necessity for constant regulation due to the varying head on the pumps, it was decided to lay the system of piping in the form of a large siphon.

A reinforced concrete pump-room, fourteen feet internal diameter and twenty-seven feet deep from the ground level to the bottom floor, was sunk at the waterside. This pump-room was built in sections, the lowest section having a steel cutting edge, and the ground in the inside was excavated and the section sunk by means of heavy weights. After one section was sunk another was made on the top of it and the process repeated. At the river side of the pump-room there are two settling tanks constructed by means of reinforced concrete sheet piles. They have removable covers for cleaning, and concrete bottoms. Gratings are provided on the inlets and the change of velocity in the water while passing through the tanks precipitates any mud or silt which may have been carried in.

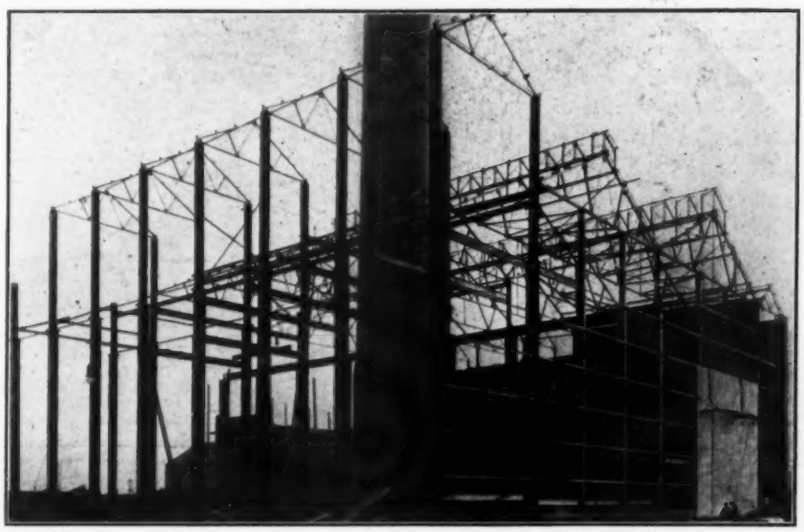
In the pump-room there are two sixteen-inch-diameter, vertical-spindle, centrifugal pumps, situated at the bottom floor, driven direct by two vertical electric motors of sixty-three brake-horsepower, each, placed at the ground level. The pumps were put below the lowest water level so that water could always be obtained in emergency. The motors are started and controlled from the engine room in the main station, and, to allow of this, automatic reflux valves are fitted at the pumps. These reflux valves gave a little anxiety at first owing to the shock with which they closed. This, however, was considerably lessened by the fitting of a small valve on the main one opening in the reverse direction and closed with a spring.

The motors may be speeded up to deliver the full quantity of water required should the siphonic action on the system fail altogether. The pump-room has a glass roof, and a number of sparred platforms at various levels allow of access to the various shaft bearings, etc. A small centrifugal pump driven by an electric motor is used for drainage when required. Had the cost not been so great it would have been preferable to have laid as much of the main pipes from the pump room to the power station as possible, below low-water level, in order to reduce the chances of air leakage and also the volume of air, should the siphon break, but the expense of this was too great and the pipes were laid at such a depth as to be only partly below water at highest tide.

The main pipe lines consist of thirty-inch-diameter cast-iron pipes supported on a reinforced concrete raft of T section carried on piles some twenty-six feet apart. The distance between the pump room and the main station is about 785 feet and between the main station and the discharge end 736 feet. The pipes are seven-eighths of an inch thick and have spigot and faucet joints, jointed with lead where laid in the ground, and flange joints in the engine room. Owing to the nature of the ground the greatest precautions were taken to protect the pipes. They were coated internally and externally with



FOUNDATIONS, PIPE TRENCH, AND ENGINE ROOM IN COURSE OF CONSTRUCTION.



STEEL FRAMEWORK IN COURSE OF CONSTRUCTION.

Dr. Angus Smith's solution at the works, then asphalted one-eighth of an inch thick and covered with a six-inch thickness of puddled clay, after they were laid. The outlet pipe passes through the concrete wall of the eastern wharf and then turns vertically downwards, ending with a short bend and bell mouth in a horizontal direction. The mouth of this end is two feet below the lowest water level. In the engine room at the highest point in the system there is a single-throw Edwards air-pump for drawing out the air which may have leaked in and which may tend to break the siphon. A number of tests have been made on this circulating-water system and one or two of the results are given below.

A mercury gauge fixed at the top of the condenser showed a vacuum of 22.80 feet of water while the tide was 22.70 feet below this level. (Owing to fluctuations the measurements could not be made very accurately, but they showed the pipe was running full bore.)

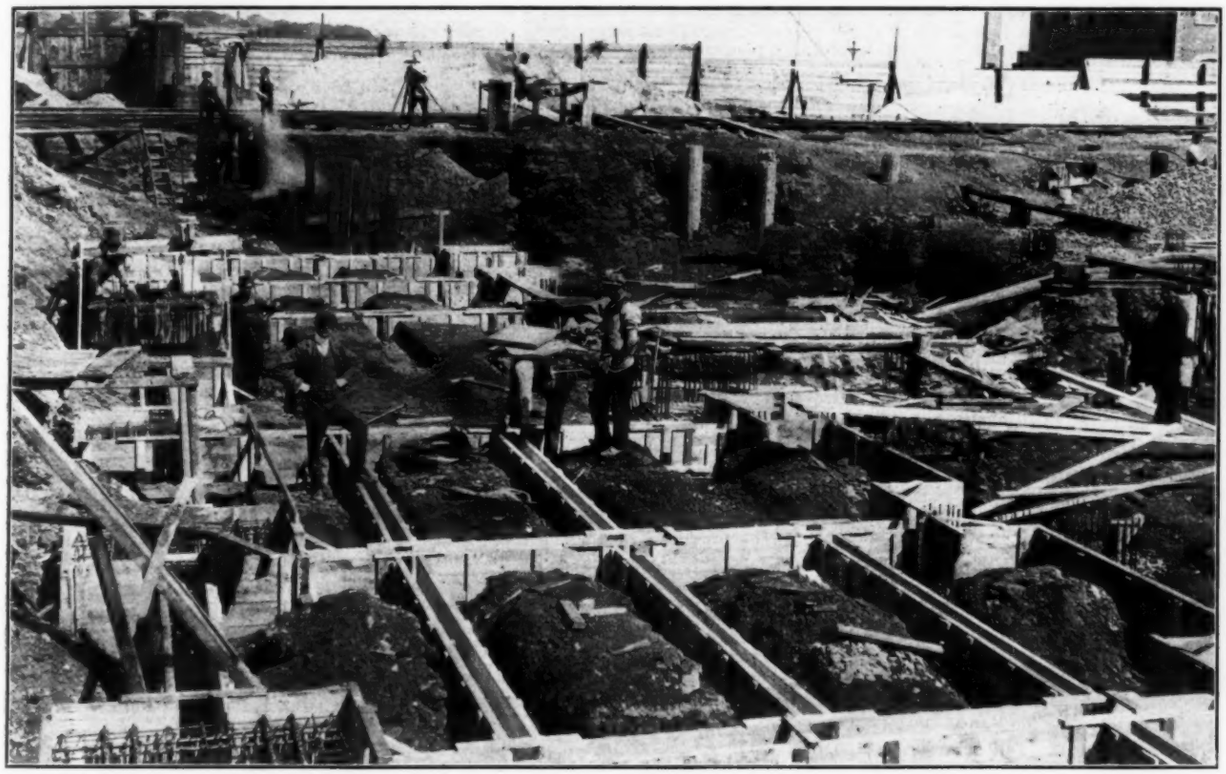
Later, during a very low tide, a gauge on the main discharge pipe in the engine room showed a vacuum of twenty feet while the tide was 20.1 feet below this point at the same time. In the main supply pipe the vacuum was twelve feet. This difference of eight feet is about the normal frictional head, so that the full effect of the return flow is utilized.

AUXILIARY PLANT.

Situated on the upper engine-room floor and above the hot wells are two direct-current generators of the Siemens bipolar type giving 600 amperes at 200 volts, coupled direct to two Willans & Robinson central-valve high-speed engines. These are used as a standby, for exciting the main alternators and for driving the works motors, etc. In the part of the engine room reserved for converting machinery are two motor-generators, one consisting of a three-phase, 6,600-volt motor coupled direct to a 300-kilowatt direct-current machine generating at 400/460 volts, and the other a three-phase motor as above coupled to two (one on either side) direct-current generators of 150 kilowatts each, generating at 200/230 volts. The motor-generators are used for feeding the district round the main station and for driving the works motors, etc. A small booster is used for charging the battery. It consists of a twenty-three-brake-horsepower motor driving a fifteen-kilowatt generator and is situated on the upper engine-room floor. A twenty-five-ton, three-motor, electric traveling-crane provides for the efficient and fast handling of the engine-room plant in the case of repairs, etc. This crane was supplied by Alexander Jack & Company, Limited, Motherwell.

WORKS MOTORS.

The works motors are all of the direct-current type, and, with the exception of the locomotive motors, work at 200 volts. Throw-over switches on the control boards of the circulating-pump, air-pump and stoker motors allow of these being run off the battery in cases of emergency should the main supply fail.



FOUNDATIONS, ASH BASEMENT AND BOILER HOUSE, IN COURSE OF CONSTRUCTION.

The whole of the cables in the works are fireproofed and are arranged as far as possible to minimize the risk of any breakdown spreading.

SWITCH HOUSE.

The switch house is 120 feet long, fifteen feet three inches wide, and has four floors, of which the extra-high-tension switchgear occupies three and the battery one. A part of this building at the west end is reserved for rooms for the station superintendent and staff.

BATTERY.

The room set apart for the battery is a model of its kind. There are three

rows of cells, with ample room for cleaning and inspection. The room is lighted from the roof by means of two rows of roof lights extending the whole length and is ventilated by large ventilators. As the extra-high-tension switchgear occupies the floors underneath, special attention had to be given to the construction of the floor to make it acidproof. The floor is of reinforced concrete on the Columbian system and is covered with blue Adamantine clinkers (six inches by two inches by one and three-quarters inches) laid on a bed of cement and grouted with bitumen. The floor is laid with falls toward the drains, which are also acidproof.

SWITCHGEAR.

A fair idea of the general arrangement of the extra-high-tension cubicles will be obtained from the cross section shown herewith. The floors are of concrete similar to the battery room, but are covered with Terrano, giving a clean finish. The ground floor is reserved for the cable-driving boxes, static dischargers, and feeder-isolating switches, the first floor for the busbars, and the second for the main oil switches. This arrangement allows all parts to be freely and easily accessible.

The extra-high-tension switchgear is in molded concrete cubicles, and the busbars, connectors, etc., are held on porcelain insulators separated from each other by concrete partitions. The fronts of the cells are protected by iron doors, those in the busbar section being expanded metal, which, while providing due protection, allows of easy inspection. The busbars are in duplicate and the two sets may be paralleled through an oil switch. To reduce the risk of a breakdown spreading, each busbar is in a separate horizontal cell by itself and has only connection to its own phase. The oil switches are of the latest British Thomson-Houston design. Each of the three phases is contained in a separate cell and there are two breaks per pole. The opening and closing of the switch is effected by the release of powerful springs, and after the latter have operated, a motor coils up the springs ready for the next operation. Static dischargers are provided on the outgoing feeders.

The control boards, both alternating current and direct current, are situated on a gallery eleven feet above the upper engine-room floor level. The alternating-current control board is of white marble and consists of nine panels, as follows,—two machine, two motor-generator, four feeders, and one interconnector. Indicating lamps on this board show whether the oil switches are in or out. A synchroscope with indicating lamps and a frequency indicator are mounted at either end of the board on swing panels.

On the feeder and motor-generator panels there are triple-pole, time-limit, overload relays, and on the generator panels there are Andrews reverse-power relays. There is a Tirrill regulator which keeps the voltage constant notwithstanding the varying load. The direct-current control-board is also of white marble and consists of twelve panels, as follows,—two auxiliary steam-generator, three motor-generator, two battery and booster, two feeder, one isolating, and two spare panels.

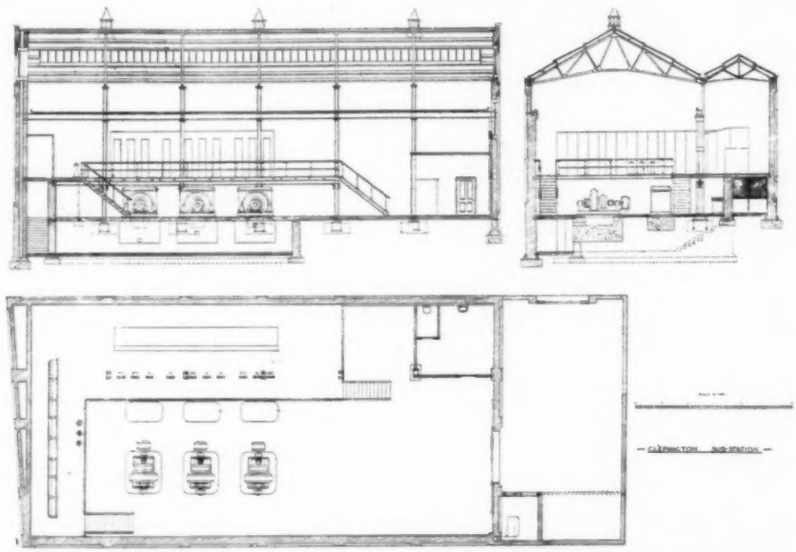
On the upper engine-room floor and underneath the main gallery are two auxiliary-plant-control switchboards, one for controlling the supply from the battery and the other from the direct-current busbars. These boards are also of white marble and consist of one panel and four panels, respectively. The framework of the boards, etc., and also the bedplates of the machines and other parts, are earthed in a very efficient manner.

All the switchgear and motor-generators at the main station were supplied by the British Thomson-Houston Company, Limited, of Rugby, England.

SUBSTATIONS.

There are at present three substations where the energy supplied from the main station at Carolina Port is transformed down to 400-volt direct-current for general supply, or 500-550 volts for tramway traction. These are situated at Clepington, in the northeast of the town; Lochee, the extreme northwest, and Dudhope, the old main station in the center.

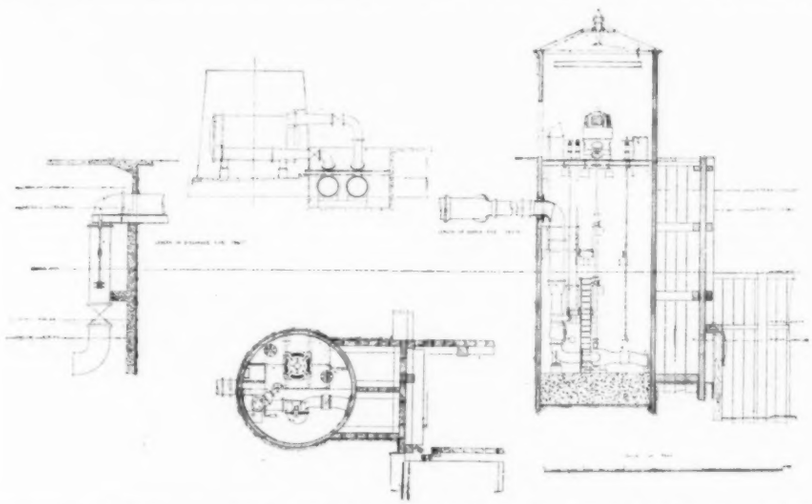
Clepington substation may be taken as a typical example. The buildings are plain but substantial and are roomy and well lighted. The floors are of concrete covered with Terrano. At Clepington there are at present two rotary converters supplied by the British Westinghouse Company, each of 550 kilowatts capacity. The rotary converters and transformers are on the ground floor and the switchgear is on a gallery, as seen from the diagram. The rotary converters are each combined with an alternating-current booster, which allows for a variation in the voltage from 400 to 550 on the direct-current side. On the end of the rotary-converter shaft there is an induction motor fed from a starting transformer for running it up to speed. The machines may be made either shunt-wound or compound, to be used for lighting or traction respectively by means of a double throw-over switch fixed on the side of the machine.



CROSS-SECTIONAL PLAN AND ELEVATIONS OF CLEPINGTON SUBSTATION.

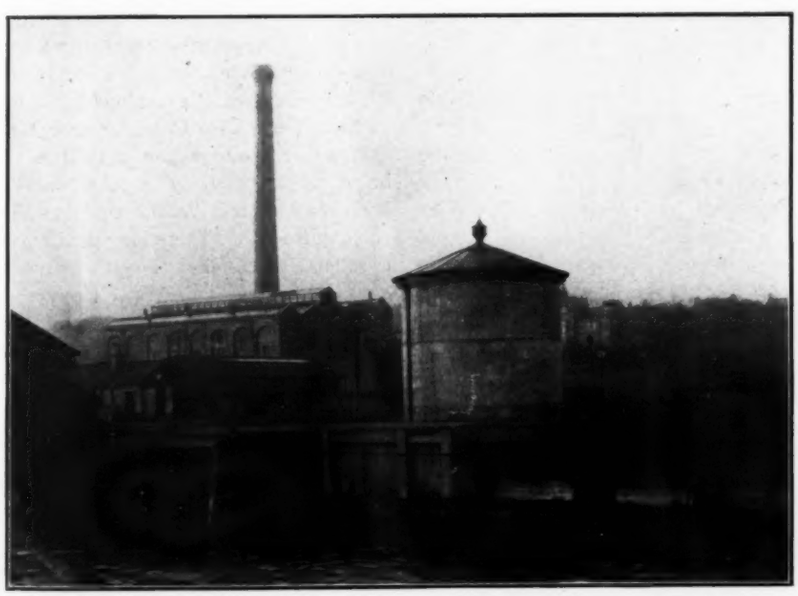
Each machine is provided with a 610-kilovolt-ampere, three-phase to six-phase, oil-cooled transformer. The switchgear and control boards in the substations were supplied by the British Thomson-Houston Company. The

extra-high-tension switchgear is all contained in molded concrete cubicles similar to Carolina Port, except that the oil switches are worked mechanically by levers from the control panels. The control board is furnished with a synchroscope and indicating lamps and voltmeter connected to transformers in the usual manner. On the incoming feeders there are reverse-current relays, while on both incoming and outgoing extra-high-tension feeders there are static dischargers. Various sections of the busbars may be separated if desired.



PUMPING STATION AND DIAGRAM OF CIRCULATING-WATER PIPE-LINE SHOWING RELATIVE LEVELS.

The direct-control board is at the end of the building at right angles to the extra-high-tension switchgear and is of white marble. At Clepington the board consists of sixteen panels and deals with the tramway traction load and the low-tension current for general purposes, the two systems being entirely separate. The general design of the board is much the same as the usual practice. Reverse and overload circuit-breakers are in circuit with the machines. The town council is at present contemplating putting down another substation at Downfield, in the extreme north of the city.



VIEW OF PUMPING STATION SHOWING MAIN STATION IN BACKGROUND.

CABLES.

The feeder cables for the extra-high-tension current transmission were supplied and laid by the British Insulated and Helsby Cables, Limited, Prescot, England. Each cable consists of three cores separately insulated with paper and the whole then protected with a lead sheath 0.12 of an inch thick. Over the lead is a covering of jute, then double steel armoring and a further covering of jute. Below the lead and insulated from it by a strip of paper is a Board of Trade copper earthing strip 0.016 of an inch thick. The cables were laid direct in the ground, heavily coated with a preservative compound, and finally covered with a specially shaped tile two and one-half inches thick. They were laid at an average depth of four feet six inches and were kept eighteen inches apart.

The following tests were carried out on the cables after they were completed:

At the works each length of cable was tested for fifteen minutes with an alternating electromotive force of 20,000 volts between cores, 13,000 volts between cores and sheathing after the cable had been immersed for twenty-four hours in water. After being laid and jointed the cables were again tested with a pressure of 13,000 volts between the cores and between each core and earth.

The sheathing of the cables was bonded to the water pipes of the city at various points. The joints in the cables were the usual extra-high-tension type, with phases stepped and the Board of Trade strip and lead and armoring electrically continuous throughout. When completed the joints were troughed and run in solid with bitumen.

There are at present two 0.1-square-inch cables run to each of the Clepington and Dudhope substations, and two of 0.05 square inches run from Dudhope to Lochee substation, making in all a length of extra-high-tension cable connecting the generating station and substations of about twelve miles.

As the ground near the main generating station is of a nature which would quickly corrode through the cables, these are for a distance of about three-quarters of a mile laid in creosoted wood troughing filled with compound and covered with a two-inch thick tile.

Where the cables pass under the main railway lines they were drawn into fireclay conduits laid with a slight fall from the center of the lines to either end to allow any water which might

accumulate in the pipes to find its way to the manholes at either sides. These manholes were built with special dampproof walls.

Heavy iron brackets support the extra-high-tension cables where they leave the main station and keep the cables twelve inches apart.

In conclusion, from the foregoing account some idea will be obtained of the work carried out by the Dundee Town Council. During the year ended April 30, 1910, the output between the old and new stations was over 7,000,000 kilowatt-hours, and the prices charged for current for lighting purposes vary from seven cents down to four cents per kilowatt-hour, while for power prices range from five cents down to one cent per kilowatt-hour.

To Supplement Steam Cars by Gas-Electric Motor Cars.

A dispatch from Atlanta, Ga., dated June 24, states that following the announcement made by the Southern Railway Company on May 31, that the use of gas-electric cars in some of the more congested districts along its lines was contemplated, it is definitely announced by that company that its steam passenger train service in the Greenville territory is to be supplemented in July by the inauguration of regular gas-electric motor-car service.

Pending the completion of three motor cars, the Southern management has arranged with the General Electric Company for the return of the gas-electric car which was used experimentally on the lines between Manassas and Strasburg, Va., during last summer.

Gas-electric motor-car service will be furnished in the Greenville territory by this car until the delivery of two improved gas-electric cars by the General Electric Company, and a gasoline car being constructed by the McKeon Motor Car Company. The cars will be completed in a few months and will be put into regular service as soon as delivered to the Southern company.

May Exports of Manufactures Largest in the History of Our Commerce.

Exports of manufactures in May were larger than in any earlier month in the history of our export trade, and for the full fiscal year 1910 will be larger than in any earlier fiscal year. The total value of manufactures exported in the month of May was $71,000,000, including in this term both manufactures ready for consumption and manufactures for further use in manufacturing, and for the eleven months ending with May amounted to $699,000,000, indicating that June, the twelfth month of the year, will certainly bring the record for the fiscal year 1910 above that of any of its predecessors. The total value of manufactures exported in the full fiscal year 1907 was $740,000,000; in 1908, $750,000,000; in 1909, $671,000,000, and for the fiscal year 1910 seems likely to materially exceed the high record of 1908. Should the June exports of manufactures equal those of May, for which the figures are just at hand, the total for the fiscal year 1910 would amount to $770,000,000. In the eleven months ending with May manufactures form forty-four per cent of the exports, a materially higher percentage than in any earlier year.

Not only will the value of manufactures exported in 1910 exceed that of any earlier year, but the value of manufacturers' materials imported will also be larger than any earlier year. The total value of manufacturers' materials imported in the eleven months ending with May is $793,000,000. The total for the full year will be fully $850,000,000, against $751,000,000 in 1907, the former high record year.

Mackay Companies May Increase Cable Service.

Advices from Boston state that the Mackay Companies probably will in the course of the next year lay another cable between England and the United States, which would give six cables between the two countries. Of this number three would be on the New York-Newfoundland-Ireland improved route, while two are on the old route to Canso and a sixth comes to Boston. The cost of such a cable would be between $3,000,000 and $3,500,000, and the company has ample funds on hand to defray the expense.

While the present volume of cable business is slightly less than a year ago in conformity with the general depression in the United States, there are other reasons which render the laying of a new cable advisable. For one thing the Commercial Cable Company has in the last two or three years suffered heavy financial loss and much inconvenience and delay in business through the damage done by fishing trawlers on the Irish coast. It is estimated that these trawlers have cost the Commercial Cable Company a good $1,000,000 during this period, and a sixth cable is something of a protection against their depredations. The cables are laid far enough apart so that damage would not be simultaneous.

Examination for Forest Engineer.

The United States Civil Service Commission announces an examination on July 27-28, 1910, to secure eligibles from which to make certification to fill a vacancy in the position of forest engineer, in the Forest Service, and vacancies requiring similar qualifications as they may occur.

Applicants should apply either to the United States Civil Service Commission, Washington, D. C., or to the secretary of the board of examiners, for application and examination Form 1312.

An examination will be held on July 27 to secure eligibles to fill a vacancy in the position of engineer in timber tests. Those desiring to take the examination should apply for examination Form 1312.

For Municipal Fire Alarms.

During a recent hearing in New York City on the question of granting a certain company a franchise to install fire-alarm systems in various buildings in New York, Fire Commissioner Waldo made the suggestion that it might be better for the city to take over the business and receive the revenue that comes from it. There are at present six such companies in the city that have connections with the fire department and use the city wires. The ordinary charge for the installation of a fire alarm box in a building is $50. Some of the companies have as many as 2,000 or 3,000 customers.

Hudson & Manhattan Franchise Assessment.

New York State Supreme Court Justice Lebours has set aside the assessment of $6,900,000 placed upon the special franchise of the Hudson & Manhattan Railway Company by the New York State Board of Tax Commissioners for 1907. The court ordered a reassessment of the property open to dispute.

Electrical Notes From Great Britain.

(By Our British Correspondent.)

The annual convention of the Incorporated Municipal Electrical Association came to an end at Glasgow on June 17. The presidential address of W. W. Lackie, the city electrical engineer by whose courteous assistance this journal was able to publish a full description of Glasgow's electricity supply system a year or two ago, contained some figures of the kind recently quoted here to illustrate the power-station economies of the last decade. When the Association met in Glasgow in 1901, the cost of electrical energy produced there, including interest, depreciation and sinking fund was 5.92 cents per kilowatt-hour. Now it is only 3.46 cents. Excluding the standing charges the works costs in 1901 were 2.82 cents per kilowatt-hour. Today they are only 1.124 cents. It is generally argued by advocates of private enterprise that municipal authorities having the public money to spend are in a privileged position as compared to private companies, but Mr. Lackie in his address pointed out the disadvantages of the municipalities, showing that electric companies may do many things that a municipality may not do. He says that it is a fallacy to allege, as some have done, that the British electrical industry has suffered through municipalities obtaining powers to raise money for electrical purposes and he holds that municipalities have done much to advance the industry, many boroughs having undertaken the supply of electricity when no company would have ventured to do so. For such authorities who have acted as pioneers, supplying cheap electricity which naturally created a bigger demand for manufactures, he asks protection of some kind now that they are finding their areas surrounded or invaded by private supply companies. A power company which can select its consumers will of course choose those that are more profitable, leaving the less profitable to be supplied by the municipality, and this leads to unfair comparison, in the same district, between the respective charges of the two suppliers. After touching briefly on the vexed question of depreciation provision, Mr. Lackie alluded to the effects of the metal-filament lamp. When this lamp was put upon the market it was said that it would be necessary to obtain three applications for every one previously received, but this had not been found to be the case because all the applications previously received were not for lighting purposes, and all the lighting is not even now done by the metal-filament lamp. Moreover, during the past few years they had, for the first time, been getting applications for the larger power supplies. "One is glad to think that no such radical change in the efficiency of motors can take place." Mr. Lackie thinks it would be good both for the supply undertaking and for the wiring contractors, if the lamps were left to the supply authority, either to be supplied and the price included in the charge per unit, or sold direct to the consumer by the supply authority. If the former method were adopted, one lamp could be given for every 100 or 200 units used, and if the latter, the price would be at most, net cost.

The chief effect of the "temporary lull in output" has been that municipal engineers have had time to put their works into better order. "The arrested progress . . . has driven us to re-examine our methods of organization to see if any untapped economies could be effected." Charges for electricity were briefly alluded to, the present lack of uniformity in methods being described as a fruitful source of trouble.

A. C. Cramb, of Croydon, in a paper on commercial advancement of electric supply urged the necessity of a vigorous development campaign, and indicated the general lines along which he considered this should be conducted. H. Collings Bishop, of Newport, followed with some notes on the commercial progress of electricity undertakings in which he spoke in favor of a "combined canvasser and illuminating engineer" having been an unqualified success at Newport, both in obtaining new consumers and in satisfying grumblers. Mr. Bishop does not agree with the American motto, "which seems to be peg away until your man gives in;" in his opinion there is a time when it is diplomatic to give a prospective customer a rest, and "the knowledge of the correct time for this should be part of the education of every canvasser." On the debated question of electrical contracting departments run by municipalities, he said that consumers were increasingly showing that they preferred to deal with these departments. It was sometimes asked, "What is to become of the contractor?" and his reply was that the properly trained and conscientious contractor had little to fear, "but the man who becomes an expert in a night must in the interest of the whole industry, go, "for the sins of the incompetent wireman very seldom fall on the individual concerned but rather on the industry as a whole."

The second day was spent at Edinburgh, where Frank Newington, the chief electrical engineer, gave an account of the exhaust-steam turbine with direct-current dynamos, and condensing apparatus, at his McDonald Road generating station. This paper is given fully in another part of this issue.

Another paper, by Ashton Bremner, discussed extensions to existing supply stations by means of mixed-pressure turbines. The third day's meeting, in Glasgow, was partly occupied with discussion on continuous records of costs and of steam consumption, and on the cheapening of cost of mains and services.

The Association Committee reported that the standard specification for bayonet socket lamp-holders was printed in draft and would be issued in due course; also that the Sub-committee on Physical Standards of the Engineering Standards Committee was engaged, in co-operation with the manufacturers, in preparing a specification for metal-filament lamps, but the completion of this specification will occupy some time yet. In conjunction with the Municipal Tramways Association the question of standardizing a method of charging for current supplied for traction purposes from combined undertakings has been studied, and a suggested method of arriving at a correct traction charge has been prepared. The Economic Wiring Subcommittee has, in conjunction with the Cable-Makers' Association, drawn up a specification for a class of conductor which would meet the requirements of fire-insurance authorities.

Sheffield Corporation may shortly spend $390,000 on extensions at its

Neepsend power station owing to industrial power demands from works, including electric furnaces for iron and steel works, several of which are already connected to the public mains. Rotherham is to spend close upon $140,000 for new turbo-generator plant, rotary converter, transformer and mains, for its undertaking; Newport (Mon.) is spending $150,000 for extending its light and power and tramway services; several corporations are proceeding with alterations to portions of their works and substations to comply with the Home Office new regulations; Wednesbury Council, having to extend, sent a deputation to different parts of the kingdom inspecting various types of engines, the result of which is a decision to install a 230-kilowatt gas engine and dynamo by the British Westinghouse Company; Coventry Corporation electricity department has been so successful this year that a small bonus for economies is to be paid to the employes. The Birmingham Corporation has approved of $716,000 being spent upon additional generating plant, and a new substation at Harborne, because the demand continues to grow by leaps and bounds. There is to be appointed at Birmingham a secretary of the electrical department, at $3,000 a year. Not all of our large municipal electrical works have yet seen how important it is to have a thoroughly well qualified official devoting himself exclusively to the financial and commercial side of the undertaking. Small systems cannot afford to stand the expense of two officials at reasonable salaries, so the chief engineer is supreme, with clerical and canvassing subordinates at low salaries. An undertaking of the size of that at Birmingham will find it well worth while having a good man, for its commercial and secretarial department is a very large one

Electrical contracting firms have for some months past been preparing for a tussle in the courts with municipal corporations who have set up electric wiring and installation departments of their own though having no definitely expressed provision for such work in their provisional orders. The Electrical Contractors' Association has been acting in the matter, and the Corporation of Leicester was selected for the attack, the prosecution being conducted at the instance of an electrical contractor doing business in that town. The case: "Attorney General v. Leicester Corporation," has just been occupying the courts for three days. The municipal electrical engineers are pretty unanimously in favor of running these departments, and they say that the electrical contractor in the past has not done much to assist the development of electricity supply. They believe that they will get more satisfactory and more progressive work, pleasing the consumer and accelerating the electrical forward movement, if they have control. The electrical contractor quite naturally complains that as he is a ratepayer in the borough, the corporation representing his interests ought not to enter into competition with his business and take away his livelihood. He, and others, too, want to know where municipal competition will end if this be generally permitted. If municipal electrical contracting and supplies selling be permitted, what is to prevent them from going in for municipal bakeries, dealing on the stock exchange, and so on? There is more money in the electrical contracting business than is sometimes stated; indeed there has been far greater activity during the last year or two, and one hears a little less now about the undercutting of prices for such work. Most of the weakness in the contracting industry seems to be due to the mushroom contractor, who is a wireman or something of that sort, and overnight gets a hundred dollars loaned by an aunt or grandmother, or a couple of hundred dollars legacy and becomes a full blown contractor. A few contracts at cut prices are secured and he keeps going by earning a wireman's wage in profit, until like Jonah's gourd he fades away, having benefited nobody and leaving the bankrupty court to hear how many electrical firms have been "let in" for the amount of their bills for material with which he has earned that wireman's wage. This sort of thing has gone on as long as the writer can remember electrically. Surely in few other departments of industry do men come and go with such frequency. The weak men take the low-priced contracts, because they are weak, hoping eventually to grow strong on their own weaknesses. The strong firms are robbed of business which might be carried out with profit to the industry if they had it, and manufacturers and electrical dealers would be paid in full. It has happened that some such firms of reputation have had to live on their reserves while waiting for business and have thus become weakened, while mushroom-growth firms have been executing work at prices which could not carry a fraction of profit unless poor material and inefficient work were put in. Losses on contracts, insufficient capital, inexperience and so forth, are at the bottom of many paltry electrical failures which are annoying, or worse, to the manufacturer and indicate that obstacle to profit-earning which injures contractors generally. From these remarks it will be observed that there are some reasons why municipal electrical departments should hanker after keeping a contracting staff under their own wing. Of course it is no new thing for them to so desire—quite a number of them have been for years working under special powers in this way. Whether others, too, can do it, to whom so far special wiring powers have not been granted, may be decided as the outcome of the present litigation.[1]

The St. Pancras (London) electrical engineer has brought forward a scheme for modernizing the Council's light and power plant. For many years supply has been given from two generating stations, King's Road and Regent's Park. For years he has foreseen the desirability of collecting the generating plant under one roof, hence the introduction of three-phase plant and the opening up of substations. The generating plant at Regent's Park will deal with the peak load only and for the remaining nine months of the year it will be operated as a substation. Two 1,000 kilowatt motor converters, three-phase trunk mains connecting the two stations, spare turbine plant, etc., at Regent's Park will cost $121,000. New boiler plant, coal and ash handling appliances, etc., at the main generating station at King's Road, leaving the existing boiler house to provide the spare boilers, will cost either $256,000 or $422,000, according to which scheme is adopted. The higher amount will include the demolition of the dust destructor and buildings and the pulling down of the existing boiler house. Mr. Baynes estimates that with the new boiler house and equipment the costs will be reduced from 2.04 cents per unit sold to 1.38 cents.

ALBERT H. BRIDGE.

London, June 25, 1910.

[1]Since writing the above, the judgment of the court has been delivered against the Leicester Corporation, the contracting interests therefore winning. But there is talk of an appeal to higher court.

American Institute of Electrical Engineers.

Annual Convention at Jefferson, N. H., June 28—July 1.

The twenty-seventh annual convention of the American Institute of Electrical Engineers, held at the Hotel Waumbek, Jefferson, N. H., June 28 to July 1, was characterized by the spirited discussion of the papers presented, which commanded so much interest that the meetings were protracted, one extra session was held, and it was necessary to request that the discussion on certain papers be presented in writing. The attendance was not as large as in former years, the total registration of members and guests totaling 178. Those present, however, were surcharged with enthusiasm, and the delightful weather made it possible to concentrate attention on technical subjects and to remain indoors at the sessions without physical discomfort.

In addition to the meetings for the reading of papers, a meeting was held on Thursday evening to discuss Section matters, and the views of the various delegates were expressed as to the relation which should exist between the Sections and the parent body. As the Chairman of the Sections Committee, P. M. Lincoln, was in Utah, he could not be present, but sent a telegram of regrets. The chair was occupied by C. F. Scott, the originator of the policy of fostering sections. As a result of the discussion, a meeting of the delegates from the various sections was held the next morning, and committees were appointed to deal with the matters at issue. The delegates had already had, in connection with the officers of the Institute, a dinner prior to the Thursday evening meeting.

On Friday evening there was a dinner by the Educational Committee and others interested in this subject, and a discussion was held on the ever-important subject of technical education. Prof. D. C. Jackson presided, and the discussion was opened by Dr. C. P. Steinmetz. Prof. M. De Chatelain, of St. Petersburg, president of the Russian Electrotechnical Society, was present at this meeting.

A dinner for Cornell graduates was held on Wednesday evening, at which nineteen former students of that university assembled.

The Convention Committee had made adequate arrangements for the entertainment of members and guests. On Tuesday evening there was a reception by President and Mrs. Stillwell, followed by dancing and refreshments. A tennis tournament was inaugurated which resulted finally in a victory for G. A. Sawin. Meanwhile a golf tournament was also in progress, the contestants being divided into three eights. In the first eight the winner was F. E. Donohoe; in the second, N. W. Storer; in the third, M. P. Rice. A. H. Armstrong carried off the prize for the best gross score, while W. E. Reed won the handicap event. Handsome silver cups were presented to each of the above.

On Wednesday afternoon, after the conclusion of the meeting, a seven-inning baseball game was arranged between the Hasbeen and the Neverwas nines. The former consisted of Messrs. Vaughan, Langsdorf, Osgood, Sawin, Blake, Klumpp, Lincoln, Van Staagen and Rundle, while the latter was made up of Messrs. Wagner, Hayden, Lee, Lloyd, Creighton, Upson, Carlton, Lawton and Hillebrand. The Hasbeens won by a score of 13-11. Prof. Geo. F. Sever officiated as umpire.

For the entertainment of the ladies a bridge-whist party was given on Wednesday evening and a golf tournament was also held. Mrs. W. I. Schlichter was awarded a parasol as first prize in the latter, while Mrs. C. A. Adams carried off a stein for second honors. Mrs. F. E. Donohoe won the putting contest which was held by electric light on Thursday evening.

On Thursday the day was devoted to a trip up Mount Washington, about half of those at the convention participating. Although the day was clear, the atmosphere was somewhat hazy, and distant points could not be easily discerned. This trip was a very enjoyable one, and formed a feature of the convention.

As already reported last week, the formal sessions of the convention opened on Tuesday afternoon with the presentation of the president's annual address. President Stillwell took the "Conservation of Water Powers" as his topic. His address was received with great applause. An extended abstract of it was given in these columns in the last issue.

The meeting was then turned over to the control of the Committee on Electric Lighting, its chairman, William L. Robb, being called on to preside. The first regular paper presented was that by Profs. C. F. Harding and A. M. Topping, entitled "Headlight Tests."

HEADLIGHT TESTS.

This paper gives the results of extensive tests conducted by the electrical engineering department of Purdue University. These tests were made for the Indiana Railroad Commission in order to determine whether the compulsory use of more powerful headlights on steam locomotives was desirable. The tests were divided into two distinct groups, the first comprising road tests on the Big Four Railroad near Indianapolis; the second group comprised laboratory and outdoor tests carried on at Purdue University. In the road tests an observation car was equipped with oil and electric headlights, and was run some 5,000 feet back from a set of home signals. Eleven observers on this car noted the colors of the home signals as these were changed. The tests were conducted with an opposing locomotive equipped with electric and also with oil headlights to determine the effect of opposing headlights upon the accurate identification of the signal. Classification signal tests were also made with the same observation car, the observers endeavoring to distinguish the color of the classification signals placed adjoining the smoke stack of the opposing locomotive. Obstruction tests were also made where various obstructions were placed upon the track and an attempt was made to indentify their character at various distances with oil and electric headlights upon the observation car. The conclusions arrived at from these road tests were that a powerful headlight is a marked disadvantage in that it causes reflections from glass roundels and lenses, thereby producing false or phantom signals; a powerful opposing headlight adjacent to block signals so obscures the latter as to make it difficult to read them at distances over 1,000 feet; that opposing oil headlights of ordinary intensity allow such signals to be read correctly at 4,000 feet or less; that with an opposing headlight the distance in which the signal can be read correctly is slightly reduced by the use of a powerful headlight; a more powerful headlight on an approaching engine obscures the classification signals on that engine to a marked degree, particularly with green signals in the glare of a powerful headlight; that opposing oil headlights allow either white or green signals to be read at a distance of 400 feet or even more; obstructions on the track cannot ordinarily be seen with a powerful electric headlight at a sufficient distance to prevent accidents, since a train traveling at a high rate of speed cannot be stopped in a distance in which obstacles sufficiently large to cause a wreck were first detected. The laboratory tests comprised four separate series made on seven different types of lamps, including luminous arc, carbon arc, kerosene and acetylene lamps. The four series were as follows: Determination of the illumination produced by the headlight at a fixed

point in the axis of a reflector; determination of the total light flux generated by the lamp; determination of the illumination produced along a course of 1,300 feet in front of the headlight; a spectro-photometric analysis of the light from each lamp. In addition to these tests there were made spectro-photometric analyses of the light reflected from roundels and determination of the reflective coefficients of the roundels with and without signal lamps. The conclusions regarding this second group of tests were as follows: The magnitude of the illumination is a function not only of the total light flux emitted from a lamp, but also its distribution; that reflector in which the largest total light flux falls in the vertex will have the highest multiplying factor; the lens type of projector has a higher multiplying factor than the reflector type; the spectral intensities of the luminous arc headlights are not noticeably different from those of the carbon arc; the oil headlight gives intensities higher in the red and lower in the green than all other headlights tested; the reflected light from green roundels has a higher intensity in the green than that from red roundels and this intensity is greatly augmented when a signal lamp is placed behind the roundel, as is done in practice.

C. A. B. Halvorson, in opening the discussion of the paper, considered that proper reflectors were superior to lenses. Strong headlights could be used if they were extinguished when passing another locomotive.

J. B. Taylor inquired whether the observers had been tested for color-blindness.

G. H. Stickney suggested that the bad effects of brilliant headlights could be overcome by directing the beam below the level of the opposing engineer and placing the signals also at a height where they will not be illuminated.

Dr. C. P. Steinmetz suggested the use of brighter signals as well as stronger headlights. The beam should be controlled and directed and if necessary locomotives could slow down in passing.

C. F. Scott advocated position signals in place of color signals, and remarks were also made by H. Barker, Geo. A. Hoadley, H. P. Woods and J. C. Lincoln.

Professor Harding, in closing, said that the oil light was sufficient for the security of the engineer. On foggy nights a screen seemed to cut off vision, and this was more opaque the brighter the light. He pointed out that it was not feasible to extinguish lights in passing where the traffic is heavy. No tests for color-blindness were made, but the agreement between different observers was satisfactory. Focussing the beam would limit the distance in front of the locomotive which could be illuminated unless the light were placed very high. The Indiana Commission ruled that lights of 1,500 candlepower should be used. Semaphores could be used with the light dispersed sufficiently to illuminate them.

The next paper was on "Carbon-Filament Lamps as Photometric Standards," by Dr. Edward B. Rosa and G. W. Middlekauff. In the absence of the authors this paper was read by the chairman. An abstract of the paper was published in our last issue.

The next paper was by A. R. Cheyney on "The Modern Oil Switch, with Special Reference to Systems of Moderate Voltage and Large Ampere Capacity."

THE MODERN OIL SWITCH.

Mr. Cheyney's paper is a review of the present state of development of the oil switch, particularly as used in systems of large generating capacity. With the increasing use of steam turbines in such systems the reliability of action of the oil switches is becoming more imperative. On the whole the oil switch has given good service, which accounts for its extensive use, but the destructive action of the arc on short circuit both in fusing the contacts and in carbonizing and expelling the oil require possibly a change of design in order to insure readiness for immediate further operation. So much is dependent on the absolute reliability of oil switches that it is false economy to use a cheap form of switch; if economy is necessary it should not be at the expense of the vital parts of the switch. It is desirable to group relatively close together all the parts that constitute the switch unit, such as the disconnecting knife switches, series-transformer, relays, control wiring and the oil switch proper. On large systems a 300-ampere switch may be called on to handle an instantaneous output of over 1,000,000 kilowatts on short-circuit conditions. Carbonization of the oil by the heat of the arc under such circumstances seems unavoidable. It has been suggested to keep the oil in a set of switches under a pressure of 150 to 200 pounds by connecting to a common pressure line, a gravity or return line taking the discharged oil back to the system; this seems promising because the opening of the contacts would allow a heavy stream of oil to be forced directly across the arc, thus mechanically squeezing it out and eliminating carbonization and gasification of the oil. Simplicity of control should be aimed at, as also standardization in order to reduce the number of spare parts. Double-throw oil switches are not desirable. There is an urgent need for a new type of oil switch of the cheapest form for use on overhead 2,400-volt distribution lines; it should be automatic for certain predetermined overloads. In order to place entire reliance in the oil switches of a station periodic inspections must be made of them. A daily inspection of the mechanism should be made; also a weekly inspection of a more intimate character, including close observance of some half dozen observations, finally an annual complete overhaul including cleaning, replenishing the oil, etc., is necessary. Through close co-operation between the operating companies and manufacturers there will doubtless be developed a more powerful oil switch and one that will not require overhauling after each short circuit.

P. Junkersfeld expressed his appreciation of this paper. We need something different from the present oil switch. These switches do their work, but at great expense, and their reliability is insufficient. Reactances may be used to relieve the switch to a certain extent. The old type of switch is being made larger, but what we need is a new design.

F. W. Harris stated that on large-capacity medium-voltage lines the present switches do not open the line satisfactorily. They do the work, but very often damage themselves. He discussed in detail the troubles of the oil switch, and stated that he expects soon a solution of the problem in the form of a switch which will handle anything. The principles to be observed are, first, there should be no exposed live parts; second, the action of gravity should tend to open the switch; third, all breaks should be under oil; fourth, the switch should be self-contained; fifth, the operation should be by solenoid rather than by motor.

C. W. Stone said that switches will not open quickly under any conditions. A large amount of oil is not an advantage. The use of reactances will obviate the necessity for larger switches. Switches always do their work, and if they damage themselves, it is to save other more valuable apparatus. He prefers operation by motor rather than by solenoid.

D. B. Rushmore cited a case where a circuit of 15,000 kilowatts was opened 400 times in succession on low voltage. With high tensions the problem is harder, but the oil switch may be considered satisfactory. The throwing of oil is a relief, and not a defect. In the future it is probable that all large systems will be subdivided.

Dr. C. P. Steinmetz stated that large central stations had been made possible only by means of the oil switch. Improvement, however, is needed, but he disagreed with Mr. Harris as to the principles involved. There are two ways open to us. We can reduce the power, or we can improve the switch. Large systems must be subdivided, and reactances used. It is impossible to control unlimited power. Increased pressure in the switch is of no advantage, since we already have it present, due to the formation of the arc. The momentary power may be enormous, but it is the energy that is the important thing. We have to compromise between very rapid operation, which

might injure the cables, and very slow operation, which might injure the switch. The damage arises from the electromagnetic energy. The electrostatic energy is limited since the voltage cannot rise to more than double its normal value, and the insulation can stand the latter. The only reason that the electromagnetic energy does not do great damage is because the switch opens at zero current. This has been shown by the oscillograph, but more work should be done by the use of this instrument, if suitable college graduates could be obtained to work out the problems.

W. I. Donshea considered a new type of switch unnecessary. He finds the present oil switches satisfactory on circuits supplied by turbo-generators, although the switch is sometimes injured. The oil should be changed after one severe arc. He looks for improvements in the present type of switch.

Prof. V. Karapetoff exonerated college professors from the responsibility for not furnishing graduates suitably prepared for research work. After a question by Prof. G. F. Sever, Mr. Cheyney closed the discussion. It was formerly thought sufficient to place a reactance between bus sections of 100,000 kilowatts, but it is now regarded necessary to separate sections of 20,000 kilowatts.

WEDNESDAY SESSIONS.

The Wednesday morning session opened with a consideration of the Standardization Rules, and on motion it was decided to print only the proposed changes and distribute among the membership. Suggestions from the members will be received until August 1, and final action will then be taken.

The meeting was then turned over to the Committee on High-Tension Transmission, and its chairman, Ralph D. Mershon, was called to preside.

The first paper was by J. L. R. Hayden and C. P. Steinmetz on "Disruptive Strength with Transient Voltages." This was followed by "The Electric Strength of Air" by Dr. John B. Whitehead, and then H. W. Tobey read his paper upon "The Dielectric Strength of Oil." These three papers were discussed together.

DISRUPTIVE STRENGTH WITH TRANSIENT VOLTAGES.

High-frequency oscillations and other disturbances of limited power do not exert as high a disruptive effect on oil and solid insulation as should be expected from their voltage. As such transient disturbances are frequently caused by switching and other causes, a knowledge of the ability to guard against them is highly desirable. For this reason the authors undertook an investigation of the dielectric strength of air and of white paraffine oil when subjected to transient voltages. For producing single high-voltage impulses a direct current was impressed on the primary of a high-voltage transformer. During the rise of the current in the primary a momentary voltage impulse was set up in the secondary between whose terminals a spark gap was placed. By varying the primary current the energy back of this impulse was regulated. A large number of tests were made with needle points and with spheres of 3.8 centimeter diameter. The energy values used in the tests varied from 0.01 to over one joule. A summary of the chief conclusions arrived at from the results of the investigation is as follows:

The disruptive discharge through a dielectric requires not merely a sufficiently high voltage, but also a definite minimum amount of energy. The disruptive discharge does not occur instantly with the application of voltage, but a finite though usually very small time elapses after the application of voltage, before the discharge occurs; during this time the disruptive energy is supplied to the dielectric; the authors call this interval the "time lag of the discharge." The disruptive strength of oil seems to be about thirty times greater than that of air, and that of solid dielectrics probably is still greater. An oil gap thus requires a greater time before it discharges than an air gap, but even an air gap does not discharge instantly. An air gap therefore can protect an oil gap against momentary voltages, but not inversely. With limited available energy, the striking distance increases slower with increasing voltages and drops below the striking distance with unlimited energy; alternately the striking distance becomes entirely independent of the voltage and merely a function of the energy. At constant energy, with increasing voltage, the striking distance seems to approach constancy in a hyperbolic curve. The voltage at which the striking distance has become practically independent of the voltage is the lower the more limited is the amount of available energy.

THE ELECTRIC STRENGTH OF AIR.

The first part of this paper reviews the investigations on this subject made by Russell, Steinmetz, Scott, Ryan, Smith, Mershon and Watson. The method devised by Professor Whitehead consists in determining the breakdown voltage of the air between a central wire and a surrounding metal cylinder. The temperature and humidity of the air was readily controlled. By means of a gold-leaf electroscope the ionization which is an invariable accompaniment of electrical rupture was easily detected. The electroscope was charged and remained so until ionization set in at the critical voltage. when it discharged in a few seconds. A large number of experiments with small round wires were performed under varying conditions. The effect of the velocity with which the air was drawn through the apparatus was found to be negligible. The effects of temperature and of pressure were studied. Investigations of the critical voltage with clean round wires ranging in diameter from 0.089 to 0.475 centimeter were found to give values ranging respectively from 77,100 to 51,400 volts per centimeter. Dirt on the wire was found to have a marked lowering effect on these values. An extended series of experiments on the effect of moisture failed to show any appreciable effects. The appearance of coronas was also investigated and suggested the conclusion that the edge of the corona marks the limit of ionization or rupture. Among the results of Professor Whitehead's investigations are the following: The method permits the determination of the electric strength of air near round wires within 0.5 per cent. Temperature and pressure cause the greatest variations in the electric strength of air near a given wire. At 760 millimeters pressure there is a drop or rise of 0.22 per cent in the electric strength of air per centigrade degree rise or fall from twenty-one degrees centigrade. Water vapor or moisture has no influence on the electric strength of air; increasing moisture content probably lessens the loss above the critical voltage. There is no loss through air until the critical voltage accompanied by ionization and corona is reached. The electric strength of air is independent of the material of the wire or terminal. The critical voltage may be markedly lowered by dirt and surface impurities; this lowering may be as great as thirty-three per cent. The corona is periodic but ceases at a somewhat lower value on the voltage wave than that at which it begins. The corona has high conductivity and most of the loss takes place beyond it.

DIELECTRIC STRENGTH OF OIL.

At the beginning of Mr. Tobey's paper the characteristic properties of both medium-grade and light-grade insulating oils are described. In making tests of the dielectric strength it is necessary to use the same shaped terminals throughout, because the disruptive strength depends to a large extent on the shape of the test terminals. The disk form of terminal is preferred because of uniformity of electrostatic field and the large amount of oil subjected to stress. The dielectric strength of oil does not vary greatly with moderate changes of temperature. Upon congealing below the freezing point, however, it increases in dielectric strength. The presence of moisture affects the dielectric properties of oil very markedly. The presence of so slight an amount as 0.1 per cent of water reduces the dielectric strength to one-half that of dry oil. Therefore oil should always be placed in thoroughly dry tanks and it should be tested for moisture frequently. Of the various tests for detecting moisture the most reliable is by a test of the dielectric strength. Quite a number of ways of dehydrating oil are known. The best chemical to use is calcium chloride; it should be suspended in a perforated metal tube in the center of the tank or the oil should be forced through a receptacle containing calcium chloride. Unslaked lime (calcium oxide) may be used but does not give as quick results. Metallic sodium and calcium carbide are not desirable as they set free explosive gases. Heating the oil reduces its water content very slowly. Heating under a partial vacuum is better. Blowing heated dry air through the oil is of some service. If the amount of water present is very large it may be separated by settlement at the bottom of the tank and the relatively dry oil drawn off from the top. Centrifugal separation may be resorted to in a cream separator. The most rapid way is to force the oil through a dryer and purifier consisting of a pump and filter press, which separates not only the water but other impurities. The presence of free sulphur in oil is also objectionable because it attacks the copper. Solid paraffine dissolved in the oil may give trouble on low temperatures. At the conclusion of Mr. Tobey's paper he points out that tests of insulation resistance are not a reliable measure of its dielectric strength, as the insulation resistance is largely dependent on temperature.

D. B. Rushmore opened the discussion by calling attention to the fact that the dielectric strength of air puts a limit to the voltage which may be used in high-tension transmission. The suspension insulator raised it from 60,000 volts to the present value. The altitude of the line is an important point, since the strength of the air is

lower at higher altitudes. It has been noticed that porcelain insulators sometimes puncture on transient voltage under conditions such that with steady voltage the discharge would flash over the surface. The relation which connects breakdown with energy and with ionization is not obvious. These factors must affect the voltage. The effect of frequency on breakdown strength is not given in these papers.

Prof. V. Karapetoff pointed out the analogy between these problems in electrostatics, and similar ones in elasticity. It is strain and not stress which determines breakdown. Transient loads present further complication on account of introducing inertia. In electrostatic tests, as with strength of materials, poor shapes were used at first, with no simple relation to the constants of the material, but the later tests have been chosen so as to determine these constants. In electrostatics we have only one kind of stress. With transient voltages, the full voltage cannot be instantaneously applied, since it is balanced by counter electromotive force, induced by the rush of charging current, just as in the case of applying suddenly a heavy weight to a bar, the full force is not balanced by stress in the bar, but partly by the inertia of the particles. It is a shorthand notation to speak of the strength for steady voltages as different from the strength for transient voltages, since the actual strength must be a definite thing, and it is confusing to our ideas to make use of these terms.

P. H. Thomas asked some pertinent questions, and Dr. A. E. Kennelly made a suggestion to explain the apparent greater strength when using small wires. Just as there is a translatory force acting upon a magnet in a converging field, so also polarized air particles would be attracted to the surface of the electrode, and might produce an increased density at the surface giving increased strength.

W. H. Pratt raised the point that moist air might in practice be conducting, even though not so in the experiments, on account of the action of condensation nuclei.

Prof. E. E. F. Creighton gave the results of some of his own experiments on dielectric spark lag, and considered that this time lag must be taken into account in transient phenomena. The air may deionize between reversals of the wave. Respecting Doctor Whitehead's results with dirty wires, he had had a similar experience, but does not consider the reduced strength as due to the rough surface, because when the surface was reduced chemically, the voltage for breakdown rose again, although the surface was still rough. The difference must be due to the chemical nature of the surface.

J. C. Lincoln and C. F. Scott spoke on the subject, and the latter presented a contribution from S. M. Kintner, who had made some experiments with a steam jet between a locomotive and a trolley wire. No effect was noticed, with the steam directed either transversely or longitudinally, showing that moisture in this form does not affect the dielectric strength. This supports Professor Whitehead's results.

A written communication from Prof. H. J. Ryan stated that he agreed with Doctor Whitehead as to secondary ionization, and discussed the conditions of ionization in the corona. He thinks the value of 40,000 volts per centimeter is too high for strength of air. Both himself and J. J. Thomson get values of 76,000 volts per inch. He thinks Mershon's work was correct, and a low value was obtained by him because of the large ionization in the neighborhood of Niagara Falls.

Ralph D. Mershon defended his own previous results, and stated that all sources of error had been carefully considered. The maximum possible error in that work was ten per cent and the results are probably correct to five per cent. The Niagara work extended over one and one-half years, and temperature or other conditions would not account for the results. The apparatus used was more refined than that at Telluride, and the work was better executed. The consideration of the vapor product had brought into agreement results otherwise discordant. He was not measuring exactly the same thing as Ryan or Whitehead, but was determining the critical point. Laboratory results are not applicable unless they can be checked under engineering conditions.

Dr. C. P. Steinmetz stated that the energy values given in his paper represent the maximum which could have been applied to breakdown, since they were the total supplied to the system. As to the voltage at the gap, this was carefully considered, and he believes the voltage at the gap had the values given. The mathematical consideration neglects two things: the capacity of the secondary and the variation in inductance. The latter does not affect the maximum voltage. Distributed capacity could only superpose an oscillation upon the main voltage, and this was no doubt the case. This was investigated, and although the conditions were varied, it showed no effect upon the results. He hopes to use some other method for transient voltage which will permit the measurement of the energy at the gap. He stated that there is a layer of condensed air near the surface of the electrode, and on account of this fhe pressure may amount to three or four atmospheres. He pointed out also that abrupt changes in the electric field will break down insulation and great care must be exercised at such points as cable ends where such changes are likely to exist. The corona has a very appreciable resistance, with the characteristics of a gas, so that its resistance depends upon the value of the current. It must be borne in mind that these measurements are indirect, and it is possible in the different methods we are measuring different things. He stated as his opinion that in the glow discharge oxygen is broken down and forms ozone. With a higher voltage, forming violet streamers, nitrogen is also broken down and combines with the oxygen, and under these conditions, ozone is not formed.

The meeting then adjourned for luncheon, and in the afternoon an extra session was held to complete the programme. Upon reassembling Dr. J. B. Whitehead concluded the discussion on his paper by answering some of the questions which had been asked. The conditions inside of his tube were not affected by the ends. The air leaving the apparatus contains both positive and negative ions. The electroscope may be charged either positively or negatively in the experiments. No other gases except air were used. He considered Professor Kennelly's idea very plausible. Deionization he considered unnecessary, as in the corona the secondary ions immediately combine. The presence of primary ions does not affect corona, spark or arc.

H. W. Tobey stated that the melting point of the oil used in his experiments was about minus ten degrees centigrade. No damage is done to the oil by freezing. It does not get hard, but only mushy, and cannot hurt the apparatus. It is very important to maintain dry oil, since the design of apparatus is based upon constants for dry oil. One per cent of water will mix with the oil, and must be in a very finely divided condition. A larger quantity will separate out.

The next paper was by Dr. A. E. Kennelly on

VECTOR POWER IN ALTERNATING-CURRENT CIRCUITS.

Doctor Kennelly's paper opens with a consideration of the three classes of vectors, rotative, non-rotative and stationary. Stationary vectors are rotative, but non-rotating. He then takes up the conventional representation of rotative vectors and finds that each of the two principal systems of representation, namely, by projection from the "clock" diagram to rectangular co-ordinates and by intercepting circles with polar co-ordinates, can be carried out with a positive or negative rotation of the vectors. Each, if consistently carried out, is logical, but some writers use one and others the other, whereas it is deirable that the phase rotation of vectors be standardized. The majority of writers use the positive direction which makes a leading current lead, and a lagging current lag, with respect to its electromotive force. This the author calls direct representation and he advocates its exclusive use in place of inverse representation. By universal agreement mathematicians have arbitrarily determined counter-clockwise rotation as being positive. Similar agreement should be reached respecting the conventional representation of alternating-current vectors. It

has been claimed that a complex harmonic quantity is capable of being represented by polar co-ordinates only. While the simple clock diagram with a projecting circle and uniform angular velocity of the radius vector cannot be used to represent a non-sinusoidal or complex harmonic wave, it is possible to do so by changing the shape of the projecting curve. The author shows, for instance, a sharp triangular wave and its projecting as well as intercepting curves. When treated as vectors, impedance, admittance, reluctance and permeance are essentially non-rotative vectors. Rotative vectors, such as electromotive force and current, are frequently considered as stationary vectors, when it is desired merely to show the phase relation between them and not their projective properties; in this case root-mean-square values may be used in place of maximum values. Power has been represented as a rotating vector having double the angular velocity of the potential or current vectors and having its origin or axis of rotation displaced from the origin of these vectors. More commonly power is considered as a non-rotative vector without reference to the double-frequency of rotative-vector power. 'Just as we can have triangles of impedance, showing its relation to resistance and reactance, and of resultant potential difference, showing its relation to effective and reactive potential differences, so we can construct a power triangle showing the relation of apparent or resultant power to effective power (usually called "real power") and to reactive power (frequently called "wattless power"). These terms, also "wattless current," are inaccurate because all power is real and "wattful." Similarly to the power triangle, one can be constructed showing the resultant energy, effective energy and relative energy for each cycle. Similar triangles can also be constructed for the apparent conductance or admittance, effective conductance and reactive conductance or susceptance and for the resultant current, effective current and reactive current. Whether the triangles are upright or inverted depends on whether the inductive or condensive reactance predominates and whether the phase of the current or electromotive force be taken as standard. If both or either of the last two quantities are not sinusoidal the six vector triangles permit of being considered as equivalent sinusoidal triangles, but the eighteen vector quantities cannot be strictly interpreted physically. However, all these vectors can be connected by ordinary vector arithmetic without involving double-frequency products. The stationary vectors, electromotive force, current, power and cyclic energy have rotative properties, those of the first two being well known. The power vector may be involved at double the angular velocity of the current and about an origin displaced from the main origin by a distance corresponding to the steady average power. The projected waves show the cyclic oscillation of the resultant power and the reactive power. Similarly the energy vector may be revolved to show the cyclic changes in the energy. This is done ingeniously by considering a wheel rolling on a rail; the tread of the wheel has a radius corresponding to the effective cyclic energy and the flange has a radius corresponding to the apparent or resultant cyclic energy. The projection of a flange-point upon the rail shows the energy in the circuit, the path of the flange-point is an oblate trochoid for reactive circuits and a cycloid for non-reactive circuits. In conclusion, Doctor Kennelly points out that the algebra of alternating currents may be regarded as the same for direct currents, for power as well as for other quantities. Thus, when complex numbers are substituted for real numbers, any formula relating to direct-current circuits is also a formula relating to single-frequency alternating-current circuits.

Dr. C. P. Steinmetz considered the introduction of power in the vector diagram as very interesting, but also complicated, and this is an inherent difficulty. He regarded standardization desirable, if it were feasible. It must conform with the mathematical conventions already established. He proceeded to show that the use of a polar diagram was in conformity with mathematical usage, and yet resulted in a different diagram from that obtained by considering the harmonic quantity as represented by the projection of a rotating vector.

Prof. D. C. Jackson favors the "direct" system, since it is in conformity with the usual measurement of angles, and the representation of simple harmonic motion. The other method is largely due to Doctor Steinmetz, and if his influence were thrown upon the other side, it should be easy to get uniformity.

Other remarks were made by W. W. Crawford and L. T. Robinson. A motion was made by Gano Dunn, and seconded by J. B. Taylor, to recommend the whole matter to the International Electrotechnical Commission for consideration and ruling. This motion was carried. Doctor Kennelly stated that an unofficial meeting of that commission would be held in Brussels this year, and an official meeting in Berlin next year, at which time it might be possible to secure some action.

The paper on "Determination of Transformer Regulation Under Load Conditions and Some Resulting Investigations," was next presented by Prof. Adolph Shane.

DETERMINATION OF TRANSFORMER REGULATION.

Professor Shane questioned the accuracy of the results obtained in the common method of calculating transformer regulation by adding the impedance volts vectorially to the impressed pressure, the impedance data being obtained by the short-circuited secondary method and the measurement of the resistance of the windings. He therefore devised two new methods, one a direct lation and finds them to possess a very high lation and he finds to possess a very high degree of accuracy and to check each other perfectly. In his direct method two transformers. *A* and *B*, exactly alike, are connected to the same source of power with their secondaries connected in opposition series; the voltage between the open ends of this series connection is zero until load is applied to one of the transformers. when this voltage is equal to the true impedance pressure of the loaded transformer. A third transformer, *C*, is similarly connected with its secondary in series with the other secondaries, but in opposition to that of *B*. A galvanometer is connected between the free terminals of this secondary series system. Normal load is applied to *A* and the secondary winding of *C* gradually cut out of circuit, turn by turn, until the galvanometer reads a minimum. The voltage of the secondary of *C* is then the regulation volts for the transformer *A* and is read directly by means of a low-reading voltmeter. The data for Professor Shane's calculated method are obtained by connecting the two transformers *A* and *B* as in the first instance, inserting in the load circuit of *A* a wattmeter of large enough current range and low-voltage pressure circuit, which latter is connected to the open terminals of the secondary series connection, precisely where the low-reading voltmeter is connected to read the impedance volts. The wattmeter reading is the true I^2R loss of *A* under bad conditions; this reading divided by the load current gives the IR drop. Thus the impedance triangle can be accurately determined and the regulation easily calculated. No difficulty has been found in getting two exactly similar transformers. Professor Shane's two methods check perfectly with each other and with the comparatively crude method of taking load and no-load readings with an ordinary voltmeter. The methods have been tried with numerous commercial transformers and with only commercial instruments and in each instance results of high accuracy were obtained.

E. A. Wagner thought that a small error in the galvanometer would make a large error in the value found, and the use of three transformers does not recommend the method for practical work.

L. T. Robinson considers the short-circuit test not universally applicable to all types of transformer. The present methods need improvement, but it is a question whether the instruments proposed in this method would not introduce an error.

C. F. Scott presented a written communication by C. L. Fortescue and Professor Shane then closed the discussion. He admitted that his method was theoretically defective, but the error is practically zero. The detector used is a very simple one, and it is possible to use a low-reading voltmeter. The worst reactance met with in practice is small compared to the normal voltage.

The evening session was called to order by President Stillwell, who then resigned the chair to William Maver, chairman of the Telegraphy and Telephony Committee. Mr. Maver presented the first paper by himself and Donald McNicol, entitled "American Telegraph Engineering; Notes on History and Practice."

AMERICAN TELEGRAPH ENGINEERING.

Although there is not any startling technical announcement to make relative to recent progress in American telegraph engineering practice, yet within the twenty-five years past, in common with the progress in other lines of engineering, substantial developments have been also made in the telegraphic art along numerous lines, such as standardization of equipment, the adoption of improved apparatus and methods of operation which have generally resulted in increased efficiency of the plant, greater reliability of operation, a more rapid handling of the traffic, and consequent improvement in the service rendered the public. These developments have been adequate to meet the demands made upon the telegraph.

The first electric telegraph line in this country was constructed by Morse in 1844 between Baltimore and Washington. The progress of this art into favor was slow; due mainly to the necessarily high rates for service and to more or less imperfect service, the latter due largely to poorly

constructed lines and the former to heavy legal expense incurred in the effort to maintain for the Morse interests a monopoly of the telegraphic art. Morse endeavored to obtain a British patent for his electro-magnetic telegraph, but failed on the score of previous publication. Bain of Edinburgh came to the United States in 1848 to obtain a patent covering his chemical telegraph which was refused on the allegation that his device infringed the patents of Morse. Bain's chemical recorder and the House printer were described. In the early days of the electric telegraph the methods of line construction were naturally crude, but every year saw improvements in the direction of workmanship and materials used. Wooden poles were used from the first in this country, but the forms of insulators and the materials used in their construction were multitudinous, and it was not until much bitter experience was had with various "improvements" in insulators that practice converged on the glass petticoat form now universally employed in overhead electric telegraph work in this country. One of the so-called improvements termed the "brimstone" insulator was especially defective and nearly ruined several of the competing companies that employed it. This insulator consisted of an iron arm which screwed into an augur hole in the pole, the outer end of the arm carried a hollow pendant filled with sulphur into which an iron hook that upheld the line wire was inserted.

To meet the increasing demand for facilities, the Little chemical system was established in 1870 between New York and Washington, and after various improvements the speed was brought up to 900 words per minute. The Edison Keyboard perforator was also introduced and used for some years, but was finally displaced by the Morse manual system about 1876. Other automatic systems were described by the author. Duplex and quadruplex were gradually introduced from 1868 to 1872 and reached their greatest success after the introduction of hard-drawn copper wire in 1885. The source of electromotive force for telegraph purposes in this country up to the year 1855 was the Grove cell, which was displaced by a modification of the Smee cell known as the Chester battery, and this battery in turn gave way to the Callaud or Gravity battery, of which up to the introduction of the dynamo machine in the year 1882, many thousands were in use. In some of the main telegraph offices 5,000 to 15,000 such cells were employed. Generators are now used almost exclusively and as a rule public service mains are utilized to operate the machines as motor-generators. Storage batteries have been utilized also quite largely. Electrolytic rectifiers are being extensively tried out at the present time. From forty to 400 volts in steps are required in large offices. It has long been recognized by telegraph authorities, that an ideal system of telegraphy would be a simple and reliable page printer, capable of transmitting and receiving say from 600 to 1000 words per minute on circuits of from 200 to 1000 miles in length. To the inventor of such a system will ensue wealth and fame. It is hardly conceivable however, that a telegraph printer can be devised that will not possess a number of prominent defects that will act against its general employment. The superiority of the Morse manual system above all other systems is universally admitted.

Various automatic and printing systems were considered by the author, but the conditions now surrounding telegraph circuits, such as high-tension inductive disturbances, and the use of underground cables, would reduce the speed formerly obtained by the automatic systems. American operators in recent years have adopted extensively a keyboard and other semi-automatic devices for Morse transmission which increase rapidity and facility of transmission, and they have also very generally adopted the typewriter for transcribing received messages. The semi-automatic transmitting key known as the Martin mecograph, is largely used. Fast duplex service is obtained by use of the "direct point" repeater. Sextuplex is obtained in many places by super-imposing on a quadruplex circuit one or more pulsatory phantom circuits. This is known as a "phantoplex" circuit. Composite circuits for telegraph and telephone are extensively used, at least fifty such being in daily operation between New York and Boston.

Apart from the serious inductive disturbances due to the close proximity of high-tension lines, the subject of inductive disturbances on telegraph lines was not a new one, for mutual inductive disturbances between telegraph circuits were encountered as remotely as 1876 in the dry climate of some of the western states, on lines operated as simplex Morse circuits extending from Omaha to Salt Lake City. Upon the introduction of the quadruplex shortly thereafter mutual induction between parallel wires manifested itself as a disturbing factor at numerous points, due to the comparatively high electromotive force then used on quadruplex circuits, about 300 volts; and as in the ordinary operation of telegraphy single wires grounded at each end are employed, the well known method of transposing the wires at intervals to obviate mutual induction effects was not available as a remedy. Fortunately the reduction of efficiency due to this source of inductive disturbance was not very marked, and could, generally speaking, be overcome by an increase of electromotive force at the terminal stations to 375 or 400 volts. The various methods which have been suggested to ameliorate the disturbances due to mutual induction were then considered by the author. Main line relays and the testing of circuits also received consideration.

Owing to the confusion and general disarrangement of business that usually follows the prostration of the telegraph wires by severe sleet or wind storms in this and other countries, every notable occasion of this kind has been followed by insistent demands on the part of the interested business communities that measures be taken to prevent a recurrence of these disarrangements. So much has this been the case that in Great Britain, at least, where such storms are very frequent, these demands have been met by the British government by laying an emergency telegraph cable between London and North Britain. The average life of pole is about ten years. Wires would long ago have been put underground were the difficulties not insurmountable. Increased capacity and mutual inductance in cables reduces length of circuit that may be used. Stronger pole lines have consequently been frequently advocated. The well-known "A" and "H" methods of setting poles add considerably to stability, but double expense and require more room. The employment of re-inforced concrete poles for telegraph purposes has been suggested as offering a solution of the problem as regards durability and reliability but has not gained much headway hitherto, principally owing to the present high cost of such poles and also to the excessive cost of transportation. Even, however, if experience should show that cement poles will possess the ability to withstand the strains brought to bear on them by wires heavily coated with sleet, there still remains the unfortunate fact that the wires themselves may break under the strain. It would of course, be a decided gain to avoid the total loss of miles of pole line by the collapse of the poles like bricks in a row —a not infrequent occurrence under present conditions. Quadruplex operation has been much reduced in efficiency of late, due to the increased amount of underground cable and to increased inductive disturbances from parallel high tension transmission lines. Previous to introduction of these factors, duplex and quadruplex had reached high efficiency, and in isolated sections still do.

R. W. Pope opened the discussion with reminiscences of the early days. The Morse system was succeeded by mechanical printers and other improvements which have since passed out. He told of the Hughes and the House printers and their use, and also referred to the high-speed and chemical systems. The latter was at one time in general use in New England. Coming down to modern conditions, he stated that there has been more improvement in conductivity than in insulation. The present glass insulator has been in use for forty years. A page printer was needed to make the printing system successful.

J. B. Taylor spoke of the disturbances from other lines which had interfered with the use of quadruplex. He inquired why metallic circuits had not been used. Insulation could be improved without great expense. He discussed the best arrangement for composite work, and inquired why the Rowland system, with octoplex and a page printer had not come into use.

Gano Dunn told of his experience as a telegraph operator, and inquired as to the use of the mecograph, which has difficult adjustments, and is not suited to long lines. He does not consider that telephony is likely to displace telegraphy. "Wireless" has brought a conflict between the Morse and Continental codes. The Morse is more rapid.

Wm. B. Hale described the Mexican telegraph system which reaches to every village requesting it. Duplex and quadruplex are mostly used with manual operation, and a No. 8 or No. 9 galvanized wire. The use of the telegraph is enormous, as it is applied to both social and business purposes. Card telegrams bearing simply a five-cent stamp and a ten-word message may be dropped in street boxes for local transmission. The earnings in the large cities balance the deficit in the small towns. He considers the best wire to be a copper-clad iron wire. The Mexican peons will confiscate copper wires if these be used in the rural districts. He advocates a federal telegraph system.

William Maver in closing the discussion stated that Charles Wheatstone had made a page printer, but it was slow and not much used. The mecograph is used by about eight-tenths of the operators in this country. It has been used duplex, with three repeaters, between New York and San Francisco.

The paper by Arthur B. Smith on "Telephone Engineering Around the Golden Gate" was next presented, but on account of lack of time it was requested that discussion be submitted in writing.

TELEPHONE ENGINEERING.

Mr. Smith's paper describes some of the latest features of automatic telephony particularly as exemplified in the exchanges at San Francisco and Oakland, Cal. These cities lie on opposite sides of San Francisco Bay and have respective populations of 350,000 and 250,000. Contiguous to Oakland are Berkeley, Alameda, and other smaller cities of a population of 60,000. All these cities are connected by an automatic telephone system. The first exchange was installed at Oakland in May, 1907, and is of the three-wire, trunk-release, common-battery type with Keith line switches. In 1909 an automatic sytem of the recent two-wire type was installed in San Francisco. In the exchanges in Oakland and its suburbs the automatic switch equipment comprises line switches, first, second and third selectors and finally connector switches, all of which are of the standard type. In the San Francisco offices secondary line switches are inserted between the primary line switches and the first selectors. The system there being of the two-wire type without ground return, the operation of the calling system is different from that in Oakland, although the manipulation of the calling device by the subscriber is the same. The calling dial has ten finger holes that are both numbered and lettered. Special dials with Chinese characters are used for the numerous Asiatic subscribers. One of the advantages of the automatic system is that it gives equally good service in speed and certainty of calling, regardless of diversity of languages. In the San Francisco installation measured service is exclusively used, meters being placed on the individual lines; these are attached to the line switch and have given good results. By an ingenious arrangement the meters do not record when connection is made to police, fire, information and other free lines. Private branch exchange service is provided in each of the cities; the private boards are manually operated, the operator handling all outgoing calls over a number of trunks by means of the automatic calling device. Transbay service between the two large cities and other suburban toll service is handled in a unique way by the so-called "rapid-fire" method to gain speed of service. Instead of handling such calls by separate recording and line operators, as in long-distance service, the entire operation is performed by the suburban recording operator, who records on a ticket the number called for and the number calling and then proceeds to call the transbay subscriber directly with her calling device without the intervention of the distant operator. During this operation a checking operator verifies the number of the calling line by an independent and original method and if an error, intentional or otherwise, has been made the transbay connection is not completed until the correct number of the calling line is ascertained, so that the toll can be properly charged up. From public telephone stations a prepaid toll service is arranged for. Although the San Francisco system is a two-wire system and that in Oakland a three-wire system, no difficulty is met with in establishing connections between the two cities through the suburban toll boards. The entire installation in the Golden Gate district shows the flexibility of automatic telephony and its ability to meet practically any problem presented.

David B. Rushmore, as chairman of the Industrial Power Committee, was then called to the chair and introduced F. G. Gasche, who presented a paper on "The Interaction of Flywheels and Motors When Driving Roll Trains by Induction Motors."

INTERACTION OF FLYWHEELS AND MOTORS.

The load on rolling mills is so variable that troublesome or even dangerous speed variations of the prime mover result unless there are flywheels in the system of motor drives. It is inexpedient to provide suitable flywheel effect on the prime mover to take care of the load fluctuations of the entire system. Therefore, the logical thing to do is to put the flywheel on the rolling-mill motor shaft. The placing of the flywheel there accomplishes four things: First, it provides a reservoir of energy exterior to the power plant in excess of the structural and commercial possibilities of flywheels on the prime movers or of storage batteries; it equips the roll trains with an independent means of freeing the rolls of the bars in case the motor becomes suddenly inoperative; it raises the load factor of the power plant; and it reduces the size and cost of the motor installations. The inertia effect of the rotor of the motor aids it in overcoming the shocks of the service. This would seem to make possible the use of a motor of minimum slip and sufficient torque to equal the roll-train resistance when working at its most economical load. The alternative is to use a motor of lower rated capacity, having a greater slip in coming to full torque, and to supplement the tardy response of the motor by the action of a suitable flywheel. On some types of small mills the first type of motor drive may give a slightly higher electrical efficiency, but the flywheel is usually a necessary adjunct for most rolling-mill motors. By means of energy diagrams and mathematical analysis Mr. Gasche proceeds to develop formulas for the determination of the tangential forces acting at various stages of the "pass" and the interval between "passes" or throughout the cyclic operation of the roll train.

Dr. C. P. Steinmetz stated that rolling-mill work presented the most severe conditions to which electric motors had ever been subjected. The work is harder than railway service. The fluctuations of load are very rapid, although definite. There is sometimes a change in load from a mere friction load to full load within one revolution of the motor. This is another case of transient phenomena as is evidenced by the exponential term which appears in the formulas.

C. F. Scott found it interesting that the electric motor was not only replacing the steam engine, but was doing a great deal more which the engine had never been required to do. The gas engine is especially unsuited to the direct driving of rolling mills. He stated that a motor of 4,800 kilowatts had been reversed in six seconds. The variations in the load on the generator were not over thirty per cent.

Gano Dunn considered that the flywheel had disposed of the storage battery, which, in his opinion, is an undesirable apparatus. He appreciated greatly the work in this paper, but questioned some of the statements made. He discussed the general problem of a large variable load on motors. The value of the flywheel lies in changing the gradient of the load, rather than its extreme values. This paper will lead to the adoption of flywheels in other places, where fluctuations have been tolerated, or storage batteries have been used.

FRIDAY'S SESSION.

Friday's session was called to order by President Stillwell, who turned the meeting over to the Electric Railway Committee, whose chairman, William McClellan, took the chair.

The first paper was by N. W. Storer and G. M. Eaton, on "The Design of the Electric Locomotive."

ELECTRIC LOCOMOTIVE DESIGN.

The features to be embodied in an ideal electric locomotive depend upon the point of view. There are certain essentials, however, which any electric locomotive must contain. First, mechanical parts of strength sufficient for the required service; second, motors of capacity sufficient to develop the required power; third, a reliable transmission system between the motors and driving wheels; fourth, weight on the driving wheels sufficient for adhesion; fifth, a complete control system; sixth, riding qualities which will enable the locomotive to negotiate the rails without undue damage. As to the details, no two men will hold identical opinions. The designer must view the locomotive through the eyes of the men connected with every branch of the service. The man responsible for hauling trains on schedule time is not concerned with first cost, weight, mechanical or electrical efficiency, but wants to keep his trains moving. The motive power man has much the same point of view, but looks more to the details of design. His ideal locomotive will operate safely at high speed in either direction. He would like to see a single type of locomotive that would perform any service. The general manager wants a locomotive that will meet the ideals of his subordinates and which will give reliable service at reasonable cost of operation. The cost of the locomotive is of importance to him. The electrical engineer has been supposed to be concerned only with the electric detail, such as motor design, efficiency, temperature, and the control and collecting systems, but this is no longer true. He must take the broadest view. The author then discussed the various types of transmission, including gearless and geared motors, with various mountings. For switching service a locomotive should embody the following features: Short rigid wheel base, minimum dead weight per axle, minimum total weight per axle needed for adhesion, concentration of weight near middle of locomotive, effective equalization, flexibility of framing under longitudinal twist, high center of gravity. These may be summed up as tending to produce a locomotive whose wheels may be deflected by the rails with the least movement of the mass of the locomotive. For low freight service the best design is one having a motor geared to each axle, with absence of weight in excess of that needed for adhesion. All the weight should come on the drivers. For fast freight service and moderate-speed passenger trains, leading wheels of small size should be used, and less weight is required on the drivers. For high-speed passenger service, there should be a high center of gravity, and the mass should be concentrated as near the middle as possible. Large driving wheels should be used, and the springs should be very flexible, whatever the

method of equalization. Transmission through gears and by means of side rods, and combination gear and connection rod drive were extensively discussed. The Simplon locomotives which are rod-connected with radial driving wheels, were also described.

A. F. Batcheldor did not agree with the authors as to the importance of the various points of design. The dead weight per axle, for instance, is not second in order of importance. No damage has ever been done by excessive weight here. The height of the center of gravity is of small importance; narrow springs being a greater consideration. It is a good thing to get the weight near the center. He exhibited a blue print of a new design of articulated American-type locomotive.

F. J. Sprague divided locomotives into three classes regardless of the form of motor, (1) with fixed wheel bases, as on the New York Central Railroad; (2) with bogey trucks, as on the Great Northern Railroad; (3) articulated, as on the Pennsylvania Railroad. Each one of these types may have different forms of motors. He further discussed the geared, the gearless and the side rod types. The further we get from the first two types, the further we get from simplicity. A high center of gravity is not important. Wheels should have both vertical and transverse play. He also discussed the pros and cons of distinct types for freight and passenger service.

A. H. Armstrong considered an interchangeable type very desirable on mountain sections of railroads where the speed is never high.

G. M. Eaton, in closing, criticized Batcheldor's design. He thought the track should not be required to take the entire side thrust, and made a plea for plate frames. He does not know of any high speed locomotive with low center of gravity.

The next paper was by H. S. Putnam entitled "Power Economy in Electric Railway Operation—Coasting Clock Tests on the Manhattan Elevated Railway."

POWER ECONOMY IN ELECTRIC RAILWAY OPERATION.

This paper gives the results of a series of coasting tests on the Manhattan Elevated Railway in New York City. Coasting implies shutting off the power as soon as the train has been properly accelerated and allowing it to run with the momentum attained until the brakes are applied; marked power economy is achieved by this practice. In order to reduce the power consumption to a minimum, the percentage of the coasting time to the time of the entire run between two stops should be a maximum. This is attained by a high rate of acceleration and a high rate of braking, as well as by reduction of the station stop to the smallest number of seconds possible. Each of these factors is about equally effective in increasing the coasting and reducing the energy used. From a calculation from speed-time characteristics the theoretical coasting on the Manhattan system is 27.5 per cent of the total time including stops. This figure can be exceeded, but beyond a certain amount excessive coasting would interfere with the train schedule. In order to increase the amount of coasting it was regarded as desirable to enforce a better manipulation of the trains by the motormen and this was accomplished by the installation of coasting clocks on all trains of the Second Avenue line. Those clocks show automatically the entire time that the motorman has spent in coasting, which in proportion to the entire time of his run readily gives the percentage of coasting and therefore whether he shall be given credits or demerits on his performance. On the Second Avenue line it was found that the installation of the coasting clocks raised the percentage of coasting from ten per cent before to thirty-eight per cent after the clocks came into use. Integrating wattmeters on the feeders for this line showed a saving of twenty-five per cent in the power required. A series of tests were then made on all the lines of the Manhattan system to determine what the actual percentages of coasting were. With the experienced motormen of of the Second Avenue line the average costing in three runs was 45.2 per cent, indicating a possible saving in power consumption of thirty-four per cent. On the other three lines the average percentages of coasting were 13.2, 22.3 and 20.1 respectively. On a subsequent test, when the motormen were less conscious of being observed, the average amount of coasting actally followed on the lines not equipped with the coasting clocks seemed to be only about twelve per cent. In conclusion Mr. Putnam advocates the coasting clock as a better check on the amount of coasting than any direct power measurements.

This paper and the following one by C. J. Hopkins, on "Economy in Car Operation" were discussed together.

ECONOMY IN CAR OPERATION.

The object of Mr. Hopkins' paper was to show the economics resulting from "coasting" of electric cars and from the use of ball bearings. The installation of coasting signs as an aid to the motormen in the Philadelphia subway resulted in a saving of about one-third in energy consumption and nearly as much in brake maintenance. Moreover, riding was made much smoother and pleasanter, due to the decrease in duration and violence of braking. As a verification of these statements a series of tests was conducted on the Atlantic City & Shore Railroad, which has an interurban line 15.2 miles long. The tests were made with two exactly similar thirty-six-ton cars, one of which had ordinary brass bearings on its main journals and the other had ball bearings. These cars were run under identical conditions and energy input and speed observed. During acceleration the ball-bearing car had an advantage of 25 to 100 per cent over the other car. Further economics were observed during coasting and braking. The controller losses were found to be less also. In some of the tests the time that the current was on was about nine per cent less with the ball-bearing than with the plain-bearing car. The net saving in energy input in the two series of tests was found to be twenty-one to twenty-three per cent in favor of the ball-bearing car. Mr. Hopkins states that in the line of anti-friction bearings the ball type is preferable to the roller type; rollers are apt to become bent or tapered. Ball bearings also do not heat nearly as much as the ordinary type. Therefore, Mr. Hopkins summarizes the advantages of ball bearings as permitting more coasting and its resultant greater comfort to passengers, decreased maintenance charges of brakes and also of motors, saving in energy, increased reliability, avoidance of hot journals and saving in lubrication expense. Ball bearings give no trouble and require lubrication only twice a year.

A. H. Armstrong considered that the saving by rapid acceleration was well demonstrated. He considered it best to get a steep slope on the speed curve during series operation of the motors, and more uniform speed during later parallel operation. Mr. Hopkins would have gotten better results by using a higher gear ratio with ball bearings.

N. W. Storer thought that instructions to motormen would put a stop to inefficient operation. He was glad to see that ball-bearings operated so well, but thought that too much was attributed to them when the acceleration was not the same in the two cases.

L. B. Stillwell stated that the coasting clock has brought the performance of these roads up to that for which they were designed, and has reduced the coal consumption. The saving amounts to about $1,000 per day.

F. J. Sprague, referred to the apparatus for automatic acceleration, which took this out of the hands of the motorman. The coasting and braking are still personal matters, and this check on the time of coasting is the next step in advance. He predicted the general use of ball bearing on railway motors, where the benefit is greater than on the trucks.

G. H. Hill thought that automatic braking, especially at high speeds, is the next step. The friction saving is valuable, but reduction of the dead weight per passenger is much more important, and this is now receiving attention.

William McClellan considered this latter fact one reason for the recent success of the storage battery, and spoke of the benefits of rapid braking. In the absence of R. W. Harris, his paper upon "A Method of Determining the Adequacy of an Electric Railway System" was presented by the chairman.

DETERMINING ADEQUACY OF AN ELECTRIC RAILWAY.

On account of frequent contentions of inadequate service, a method of determining the adequacy of an electric railway system is important. The author describes the methods followed in determining the adequacy of the Milwaukee Electric Railway and Light Company's system. This investigation was undertaken on behalf of the Railroad Commission of Wisconsin, which is the public service body of that state. A trained force of inspectors was employed to make observations on the various lines of the system. Fine peak periods were distinguishable in the traffic movement, the morning and evening rush-hour peaks being greatest and the noon-hour and evening theater peaks smaller. Greatest attention was concentrated on the rush peaks. The inspectors observed and recorded a large number of data at various important points on each line; among these data were the number of passengers in the car proper in the front and in the rear vestibule, leaving the car, boarding the car, class of passengers, conditions of street traffic, etc. The traffic was studied as to origin and destination, location of factories, transfer points, etc. The proportions of seated and standing passengers, and of vacant seats were determined. The data were compiled in both tabular and graphic forms, a large number of curves being drawn to show various conditions of traffic movement and operation. Car-demand curves in particular were found very valuable for each line, as they show the time, amount and duration of travel, origin and destination of passengers, and other characteristics. It was found that a certain number of passengers apparently preferred standing, so that to the forty-two seated passengers eight additional standing passengers constituted a "comfortably" filled car. By drawing horizontal lines on the car-demand curves for the fifty-passenger capacity of each car the numbers of cars required for adequate service were determined on the various lines. A further study of the downtown section of each line was made to determine the actual headway of the cars, the average number and nature of delays and distortions of the schedule, and how these may be diminished. From this the minimum safe headway was found to be twenty seconds. The time taken by passengers leaving and boarding the cars was found excessive, although the schedule speed was higher than in most similar cities of the Central West. In some instances rerouting seemed desirable

There was little discussion on this paper, and President Stillwell again took the chair, while Dr. C. H. Sharp presented a paper by himself and W. W. Crawford on "Recent Progress in Exact Alternating Current Measurements."

ALTERNATING-CURRENT MEASUREMENTS.

The exacting demands of modern engineering work for precise alternating-current measurements have outstripped the capabilities of the older methods. The authors described the new methods and apparatus which have been developed at the Electrical Testing Laboratories, New York City. Zero methods furnish possibilities for precise work superior to the capabilities of deflection instruments. But in alternating-current measurements, zero methods have not been used to any great extent, largely because of lack of proper facilities. The electrodynamometer loses sensitiveness as the current approaches zero. The telephone is not sensitive at commercial frequencies. The vibration galvanometer is a delicate suspension instrument, not suited to all locations, and only sensitive at a very definite frequency. The authors have consequently designed a synchronous reversing key which rectifies the current and permits the use of a galvanometer. Platinum contacts are used whose angular position is adjustable with respect to the poles of a synchronous motor. This apparatus gives very good results, and places alternating-current measurements upon the same basis as direct-current measurements with respect to the sensibility of the galvanometer. The mechanical imperfections of the rectifiers so far constructed are such that the calibration as a deflection instrument is not accurate. The galvanometer used is a Paul single-pivot instrument, with fifty ohms resistance, and gives one division deflection for one micro-ampere. An ordinary portable millivoltmeter is satisfactory for measurements not requiring the maximum sensibility. For measuring the ratio of current transformers, low resistances are placed in the primary and secondary circuits, and the drops of potential in them are balanced. The ratio of transformation is the inverse ratio of the resistances. To measure the phase angle, some means of bringing the two drops into phase is needed. To do this, a mutual inductance is introduced, which adds to the drop in the secondary a small voltage in quadrature with it, and thus balances the phase displacement. The primary of this inductance is in series with the secondary resistance. To make a measurement, the resistances are balanced for one setting of the contacts and the inductances adjusted with the contact shifted through ninety electrical degrees. The ratio and phase angle are then given by the following formulas:

$$\frac{I_1}{I_2} = \frac{R_2}{R_1}\sqrt{1+\left(\frac{2\pi f M}{R_2}\right)^2}$$

$$\tan a = \frac{2\pi f M}{R_2}$$

When the phase angle is less than two degrees, the correction term in the formula for ratio may be neglected. The minimum drop of potential used is 0.125 volt at full load. Results are correct to 0.1 per cent in ratio, and a few minutes in phase angle. The use of the rectifier also permits the determination of the relative wave form of the primary and secondary currents. This use of the apparatus is described in detail. For simplicity the secondary resistance and mutual inductance were constructed as a unit. Four coils are used, two primary and two as secondary. The secondary coils are mounted upon a disk, the rotation of which varies the inductance from positive to negative values, the positive maximum being the larger. The primary has a very small number of turns; the secondary has a much larger number. To obviate the eddy currents the primary coils are wound with a number of small wires in parallel. Drawings of this instrument were given. Another method was described using mutual inductances in both primary and secondary circuits in place of the resistances. A method for measuring the magnetizing currents of transformers is also given. A number of variations of the well-known methods for the ratio of voltage transformers were described. To obtain a load of a specified power-factor for a transformer, a method is used which involves a non-inductive load placed directly upon the transformer, and a second non-inductive load taken from a second phase in quadrature furnishes the out-of-phase component of the load. The ratio of turns in a current transformer is obtained by measuring its ratio as a voltage transformer. The alternating-current potentiometer was described. It may be used for the exact measurement of both voltages and currents. As a detector a direct-current galvanometer is used with the rectifier. To bring the potentiometer current in phase with the voltage to be measured, a phase-shifting apparatus is necessary. Various exact methods of comparing inductances and capacities by means of alternating currents and modified Wheatstone bridges are known and used. For measurements of this class, the synchronous reversing key is very serviceable. In using this, a balance must be obtained of resistances and reactances. A description is given of a non-inductive shunt of 0.00024 ohm capable of carrying 5,000 amperes. The measurement of the residual inductance of an approximately non-inductive resistance is dependent upon comparison with resistances which are assumed to be non-inductive. Only resistances greater than one-tenth ohm can safely be considered non-inductive, as on low resistances the residual inductance is always appreciable. By working downward from a resistance of high value, comparative measurements will give the value desired. Resistances giving a drop of 0.1 volt may be compared with an accuracy in phase angle of 0.6 minute.

The discussion was opened by V. Karapetoff, who spoke of the four classes of alternating current instruments, none of which is suited for precise measurements. He called attention to the Northrup comparator, the Duddell thermogalvonometer, and the Guggenheimer thermal instrument.

L. T. Robinson preferred the separately excited dynamometer for ratio measurements. He also discussed a number of the details involved in these measurements.

W. H. Pratt was skeptical as to the value of zero methods in the measurement of large alternating currents. He described a standard shunt consisting of a copper tube through which water flowed. The inside diameter is five thirty-seconds inch, and the outside diameter is seven thirty-seconds inch; it carries 1,000 amperes with a temperature rise of six degrees.

C. P. Steinmetz described the use of two mercury rectifiers for measurements of small alternating currents of very high frequency upon a direct current galvanometer.

After some closing remarks by Dr. Sharp and Mr. Crawford, a resolution was presented by William Maver, Jr., extending the thanks of the Institute to the American Telegraph and Telephone Company and the New England Telegraph and Telephone Company for their courtesy in furnishing telephone service during the convention. This resolution was adopted, and the meeting adjourned *sine die*.

A list of the members and guests in attendance will be found on page 85.

THE WISCONSIN ELECTRICAL ASSOCIATION.

SUMMER MEETING AT OSHKOSH, WIS., JUNE 28 AND 29.

A very profitable and enjoyable meeting of the Wisconsin Electrical Assocation was held in Oshkosh, Wis., June 28 and 29. Considering the short notice given, of the holding of this meeting, the attendance was very good and the accommodations and entertainment features were in no way lacking. Notwithstanding the extreme weather conditions, a noticeable degree of earnestness marked the discussions, particularly at the first session, and at the conclusion of the meeting it was generally conceded that the results attained were at least equal to those of previous conventions of greater prominence.

The sessions, of which there were two, were held in the commodious quarters of the Oshkosh Yacht Club, situated on an attractive knoll overlooking Lake Winnebago. The delegates were carried to and from the meeting place in a special car which was placed at the disposal of the Association during both days.

The first meeting was called to order shortly after 2 p. m. Tuesday, June 26. Owing to the illness of President Clement C. Smith, and the inability of First Vice-President George B. Wheeler to be present, Irving P. Lord, second vice-president, presided.

A discussion of the rate situation occupied the entire first session. After a few words of welcome Chairman Lord called upon C. Nesbitt Duffy, comptroller of the Milwaukee Electric Railway and Light Company to open the discussion.

Mr. Duffy's discussion may be divided into two general divisions, one relating to electric railway rates and the other to rates for electric light and power. Referring to the former, Mr. Duffy spoke of the efforts on the part of the city of Milwaukee to force the traction companies to carry passengers for three cents. He said that in so far as Milwaukee was concerned it is conclusive that under existing conditions of high cost of materials, labor, etc., it is doubtful if the city railways can carry passengers for five cents at a reasonable profit. These conditions he said exist in nearly every city.

Mr. Duffy referred to a meeting at which he and a representative of the telephone company of Milwaukee spoke in an effort to enlighten the people as to the policies of public utility corporations. He repeated figures presented at that meeting indicating that there are approximately four and one-half billions of dollars invested in the electric railway business. There are about 1,237 companies operating over 39,000 cars, over more than 20,000 miles of track. He said that few people realize the small returns obtained from an investment of this magnitude and the large per cent of propery assessed for taxes, as compared with other lines of business.

Mr. Duffy then referred to the traction situation in Chicago prior to the passing of the Settlement Ordinance, and also of conditions in Cleveland, pointing out forcibly that all of these conditions emphasize the absolute necessity of setting aside a reserve fund which must be considered when establishing rates.

In regards to rates for electric light and power, Mr. Duffy said that the same basic principles must be applied in establishing these rates as in any manufacturing industry. He said that all of the true elements of cost which enter into the production of electrical energy must be given proportional weight. Two important elements enter into the cost analysis, which, according to the speaker should be given due consideration—the long-hour consumer with a small installation and the large power consumer.

In conclusion Mr. Duffy emphasized the importance of a flexible and practical schedule of rates. He said that the most important factor in the electric-light industry, as pointed out forcibly at the recent National Electric Light Convention, is its commercial development; and this relies entirely on an equitable system of rates.

Thomas Higgins, of Manitowoc, spoke briefly on the subject of railway rates, endorsing the points brought out by Mr. Duffy. He mentioned the increase of rates recently put into effect in Manitowoc and briefly outlined how this was accomplished.

The remarks of Mr. Higgins were followed by a very able discussion on electric-light rates by W. H. Winslow, of Superior, Wis. Mr. Winslow confined his remarks to rates for residence lighting and outlined a tentative schedule which he has proposed for adoption by the company he represents. Mr. Winslow spoke of the tungsten lamp situation and its effect on central-station revenues. He said that central-stations owe much to the lamp manufacturers for their consideration of the central station in not placing thousands of salesmen in the field to push the sale of the tungsten. They have preferred to deal through the lighting companies and are giving them time to readjust rates in order to meet the new conditions. Furthermore the high first cost and fragility of the tungsten has retarded the development sufficiently to give the central stations an opportunity to act.

However, according to Mr. Winslow, the time is not far distant when tungsten lamps will be placed on the market capable of meeting all commercial requirements and of durability equal to that of the carbon-filament lamp.

The system of rates proposed by Mr. Winslow is based on the Doherty rate and also seemed to be along substantially the same lines as a system proposed by S. Bingham Hood in a paper to be presented at the convention of the Canadian Electrical Association, received after Mr. Winslow had completed his schedule.

Mr. Winslow describes his rate as including a customer's charge, a charge on the number of rooms in the dwelling and a variable kilowatt-hour rate on energy consumed. In order to make comparison Mr. Winslow considered an eight room dwelling to which to apply these rates.

The customers charge was figured to be $4.80 per year regardless of the demand. This charge was obtained by dividing the total charges by the number of customers on the lines and covers such expenses as inspection, testing and reading meters, billing, collecting, etc. Mr. Winslow figured the per room charge at ten cents per month which provides for the installation of a scientific illumination scheme. In the case of the eight-room house this room charge amounted to $9.60 per year. The third or kilowatt-hour charge of this system was mentioned as from two to four cents per kilowatt-hour. Mr. Winslow said, however, that it would probably be fixed at three cents.

In addition to this rate Mr. Winslow proposed a temporary flat controlled rate to apply to those of the very small consumers who would have a grievance against the above mentioned rate. This

rate fixes a charge of one cent per watt per month of the maximum allowed by the indicator.

In reply to a question Mr. Winslow said that domestic appliances would be charged for on the basis of current consumed at three cents per kilowatt-hour.

F. A. Vaughan, of Milwaukee, spoke briefly on the rate situation in general. He referred to the rate situation in St. Louis which he had an opportunity of studying and said that if applied in Milwaukee would amount to a charge of thirty-two cents per kilowatt-hour. He spoke of the variance of conditions in different towns, mentioning particularly an instance where he was called upon to choose a rate for three small stations, and in examining the rates in most of the smaller Wisconsin towns found no two systems alike.

H. C. Sterling of New London, spoke on the question of rates from the standpoint of a municipal-plant operator. Mr. Sterling said that upon assuming his present duties he tried to have enforced a fifteen-cent rate. Failing in this he established a ten-cent rate with a one-cent discount which took the place of a flat rate of nine cents with an addition of ten per cent if the bill was not paid within a specified time. In replying to the question as to the profitableness of a municipal plant, Mr. Sterling said that outside of making any allowance for depreciation it is profitable. He said, however, that his experience has taught him that municipal plants are not a success.

H. G. D. Nutting of Ft. Atkinson, spoke of a rate which he was working on embodying a service charge, two demand charges, one for light load and one for heavy load, and a variable kilowatt-hour charge. The service charge is arrived at by dividing the expenses pro rata among the customers. The demand charges are arrived at by assuming a hypothetical plant for each class of consumer and estimating the charges of supplying both classes from the difference between the charges subsequent of maintaining both plants.

John S. Allen, of Lake Geneva, referred to the peculiar situation in that district wherein the peak lighting load occurs in the summer. Regarding rates, Mr. Allen said he was convinced of two things—first, that rates should not be reduced as is constantly being agitated by stations increasing the number of customers and secondly that rates should be simplified as much as possible.

J. P. Pulliam, of Oshkosh, spoke briefly regarding the traction rates on the lines he represents, pointing out that in every instance wherein rates were increased traffic increased, and when rates were reduced, and as in one instance, when the road went into the hands of a receiver, traffic decreased.

GROUP AT CONVENTION OF WISCONSIN ELECTRICAL ASSOCIATION.

Irving P. Lord of Waupaca, Wis., ended the afternoon discussion by an amusing account of the increase in rates he recently effected in Waupaca. The meeting was then adjourned to convene at 9:30 a. m. Wednesday morning.

MORNING SESSION.

A number of unsettled business matters were disposed of at the opening of the meeting on Wednesday morning. J. S. Allen, secretary and treasurer of the Association, read a statement showing the financial condition of the Association in so far as the dues of the various members were concerned.

Street lighting was the topic of the discussion in the morning, and this was opened by Irving P. Lord, who referred to the contract one Wisconsin city had with the local lighting company. He spoke at some length on the problems which confront central stations, mentioning several feasible advantages that the companies might benefit by. He stated that some cities assumed all of the responsibility connected with the lighting of their streets, with the exception of furnishing current, and he cited some of the advantages and disadvantages this arrangement brought.

J. C. Coles, of Fond du Lac, spoke of an experience that the Fond du Lac Company had recently with regard to the placing of meters. A shoe dealer in the course of an expansion of his business had additions constructed to his original business place, and in each case had wires connected from the one meter. He subsequently occupied the building across the street, and contended that he could continue to use current from the original supply.

Chairman Lord explained a similar situation in Waupaca, in which the city jail and court house, located in adjoining buildings on the same block, desired to have current pass through one meter. In this instance the railroad commission of Wisconsin decided that while both buildings were owned by the city, they were two separate buildings, and should be served as such.

W. H. Winslow said that cases of this kind demonstrate the unfairness of a minimum charge.

The question of street lighting was discussed by Ernest Gonzenbach of Sheboygan, Wis., and Wm. B. Jackson of Chicago.

Following this a report was made by the committee appointed to investigate the feasibility of the Wisconsin Association affiliating with the National Association. A letter was read from W. R. Putnam of Menominee, Mich., in which he, as a member of the committee, stated that he believed the proposed connection with the National Association would be of no advantage to the Wisconsin organization at this time. He stated that all the municipal companies would be eliminated from the organization, and that the affiliation would also have to be made with the American Street & Interurban Railway Association if the former affiliation was effected.

At the conclusion of the meeting, a vote of thanks was extended to the Oshkosh Yacht Club for its courtesy of providing a meeting place, and also to Mr. Pulliam, who acted as chairman of the committee of arrangements.

Notwithstanding the short duration of the meeting, a pleasing entertainment programme was provided. On Tuesday evening the members and guests were conveyed in a special car to Electric Park. Music was provided, and an enjoyable evening spent. The spare time during the day was occupied in various ways, many of those in attendance taking advantage of the excellent opportunity offered to indulge in bathing.

The following is a list of manufacturerers and supply men in attendance: Berlin Public Service Co., Berlin, Wis.; O. O. Tucker, Western Electric Company, Madison, Wis.; Wm. B. Jackson, D. C. & W. B. Jackson, Chicago, Ill.; Glen L. Johnson, Buckeye Electric Company, Chicago, Ill.; Donald H. Wyre, Buckeye Electric Company, Chicago, Ill.; M. L. Demming, General Electric Company, Chicago, Ill.; E. F. Berger, Midvale Steel Company, Chicago, Ill., J. C. Schmidtbauer, Julius Andrae & Sons Company, Milwaukee, Wis.; P. R. Boole, Electric Appliance Company, Chicago, Ill.; A. W. Dunham, Central Electric Company, Chicago, Ill.; J. B. McMullin, Electric Appliance Company, Chicago, Ill.; T. W. Jackson, General Electric Company, Chicago, Ill.; F. T. Andrae, Julius Andrae & Sons Company, Milwaukee, Wis.; E. A. Quarfot, Illinois Electric Company, Chicago, Ill.; E. H. Hoaglin, Rose Milling Company, Wild Rose, Wis.; W. R. Patton, Wagner Electric Manufacturing Company, Chicago, Ill.; P. E. Cowles, Eastern Wisconsin Ry. & Light Company, Fond du Lac, Wis.; H. C. Sterling, Electric Light & Water Works, New London, Wis.; W. H. Talkes, Pittsburg Meter Company, East Pittsburg, Pa.

Farewell Dinner to C. A. Tupper.

Upon the occasion of the retirement from active association with the Allis-Chalmers Company, as manager of the department of publicity, C. A. Tupper was tendered a farewell dinner by a number of friends in Milwaukee at the Gargoyle on the evening of Thursday, June 30. A very enjoyable repast was served, and brief addresses of good will and congratulation were made.

Mr. Tupper will become actively associated with the Reliance Engineering & Equipment Company, making his headquarters for the present at Milwaukee, Wis. He will be succeeded by W. M. S. Miller, who has been connected with the Allis-Chalmers Company for some time.

Following the dinner the whole party motored to Whitefish Bay. Those present were H. W. Hall, Rudolph Meisenheimer, W. M. S. Miller, H. C. Beaver, J. H. Sholes, F. S. Sly, G. E. Sly, J. Winchester Holman, Frank G. Bolles, H. A. Balding, D. A. Stewart, A. A. Gray, and the guest of honor, C. A. Tupper. Mr. Bolles acted as toastmaster.

Brooklyn Company Section Meeting.

The second convention of the Brooklyn Company Section of the National Electric Light Association, was held June 24, at the Oriental Hotel, Manhattan Beach. About four hundred attended.

The afternoon session opened with an address by Chairman E. W. Babcock, and was devoted to reports of officers and addresses pertaining to all branches of electricity by Paul Huble, F. T. McCormick, C. H. Cousser, J. F. Clute, H. P. Pope, C. H. Kemble, J. J. Leddy, Thomas S. C. Scott, R. D. Rubright and L. C. Chatfield. After the addresses a nominating committee was appointed.

Shortly after 6 o'clock the convention adjourned for dinner. In the evening the reports of various committees were read, after which the officers for the following year were elected: W. W. Freeman addressed the members before the convention adjourned.

The officers elected are: Chairman, W. W. Freeman; vice-chairman, F. J. McCormack; secretary, C. E. White; treasurer, F. C. Hill. Executive Committee—W. W. Freeman, W. F. Wells, R. D. Rubright, H. P. Wood, G. I. Jones, G. L. Knight, E. W. Babcock, M. H. Bennett, E. A. Baily, J. W. Lafferty and J. D. Campbell.

International Municipal Congress.

The International Municipal Congress and Exposition which will be held in the Coliseum, Armory and Exposition grounds, Chicago, Ill., will contain comprehensive exhibits of street lighting, transportation systems, telephones, and many things of general interest.

This exposition is to extend from September 18 to 30.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

EXHAUST-STEAM TURBINES AND CONDENSING PLANT AT McDONALD ROAD STATION, EDINBURGH, SCOTLAND.[1]

USING SEWER WATER FOR CONDENSATION.

BY FRANK A. NEWINGTON.[2]

The plant described in this paper consists of exhaust-steam turbines connected to direct-current dynamos and condensing apparatus.

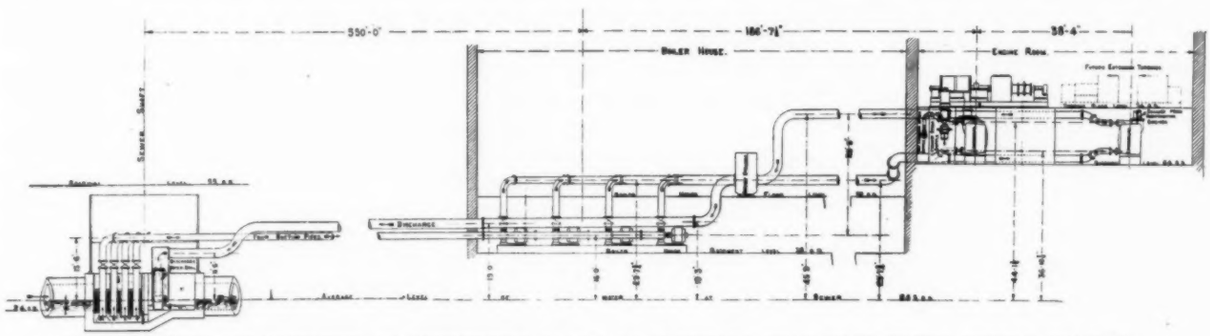
When McDonald Road Station was designed the intention was to use towers for cooling the circulating water for condensation, but this scheme had to be given up, as it was thought the towers would be unsightly and might cause a nuisance from the steam issuing from the tops of the towers condensing and falling to the ground in the form of rain. Several other methods of getting a sufficient supply of water from a distance were considered, but were found to be prohibitive on account of the cost.

In 1907, the Water of Leith main sewer, which crosses under McDonald Road about 180 yards from the generating station, was brought to our notice, and on investigation, it was found that an average flow of about 750,000 gallons per hour could be obtained. It was therefore decided to utilize the sewer for condensing, and to extend the generating plant by means of exhaust-steam turbines.

The sewer is six feet six inches inside diameter, and twenty-two feet below the level of the road. A shaft, twenty-six feet in diameter, formed of cast-iron segments bolted together, was sunk down until the top of the sewer was reached, and a ring of brickwork, of the same diameter as the cast-iron shaft, was continued downwards for about another nine feet, that is, to the bottom of the sewer. The sinking of the cast-iron shaft did not give rise to any difficulties, but the building of the lower brick ring was more troublesome, as during this part of the work there was a great deal of rain, and trouble was caused by the ground slipping in. This ring was built in sections, each a few feet wide. The chief difficulty arose in providing temporary means for carrying the water while the brickwork of the old sewer was being removed.

The method adopted was as follows: The top part of the brickwork for about one-third of the circumference was removed; an iron trough formed out of an old Lancashire boiler cut in two longitudinally was then inserted into the brick sewer, the ends projecting three or four feet beyond the shaft, both up and down stream, the joints between the sewer and the ends of the trough being made as watertight as possible. The remainder of the sewer inside the shaft was next demolished, the floor of the shaft completed and the temporary trough removed. On account of the reavy rainfall at the time, the sewer was more or less in flood, which increased the difficulties.

Four suction pipes, each eighteen inches in diameter, and one discharge pipe, twenty-six inches in diameter, are laid from the shaft to the station. Straining screens are fixed in the shaft just in front of the suction pit. The end of the discharge pipe in the sewer is water-sealed so that a siphon action is maintained.



DIAGRAMMATIC ARRANGEMENT OF CONDENSING PLANT AT McDONALD ROAD ELECTRICITY SUPPLY STATION.

Four fourteen-inch motor-driven centrifugal circulating-pumps, each with a capacity of 182,400 (British) gallons per hour, are placed in the basement of the boiler house, each pump having a separate suction pipe from the shaft. The pumps deliver into a common pipe twenty-six inches in diameter, to which is connected a Bailey & Jackson rotary strainer. From this the circulating water passes through the four condensers back through the rotary strainer, and then is returned to the sewer. The centrifugal pumps are sixteen feet above the average level of the water in the sewer, and the highest point of the pipe system is thirty feet above the pumps or forty-six feet above the

1. A paper presented at the convention of the Incorporated Municipal Electrical Association, Edinburgh, Scotland, June 15, 1910.
2. Chief electrical engineer, Edinburgh.

sewer water level, but on account of the pipes forming a closed system, the average head against which the pumps work is fifteen pounds, that is, eight pounds suction head, and seven pounds delivery head.

As there is a very considerable quantity of air in the water, two air-extracting pumps have been provided; one extracts the air on the suction side of the pumps, the other the air on the delivery side. By this means the siphon action is maintained, and the pressure at the highest point of the pipe system averages about twenty inches of vacuum.

Four surface condensers of the Contraflo type are used, each having a cooling surface of 3,750 square feet. The air pumps are of the Edwards type with three-throw cranks. The feed water force pump is also driven off the same shaft. At first the air pumps were intended to work on the dry system, but as there was some difficulty in getting the force pumps to work properly, one line of each air pump was altered so that it now delivers the condensed steam to the force pump, the other two lines working dry.

Each condenser and air pump will deal with 45,600 pounds of steam per hour with the circulating water entering the condenser at sixty degrees Fahrenheit, and leaving at ninety degrees Fahrenheit, with a guaranteed vacuum of twenty-eight inches with the barometer at thirty inches. The ratio of the weight of circulating water to condensed steam is 40 to 1. The air pumps are driven by motors geared through Renold chains.

At first the idea of using sewage for condensing does not sound very promising, but at Edinburgh it has proved thoroughly successful. The quantity of water is not as large as one would wish, but is sufficient for a maximum output of about 10,000 kilowatts. Unfortunately about 5 p. m., that is, at the time of the top load in winter, the flow is considerably reduced in consequence of paper works and other industries stopping for the day.

The chief troubles are efficient straining and getting rid of the air in the water. The straining arrangements in the shaft consists of three iron grids each five feet high and three feet six inches wide, with vertical bars spaced three-eighths of an inch apart. These are kept clean by scrapers automatically worked by a small motor. This arrangement answers fairly well, but a certain amount of scraping by hand is necessary at the time of top load. Probably it will be possible to devise some more efficient method of cleaning the grids, and so do away with hand labor.

Further straining is done by the Bailey & Jackson rotary strainer which is placed between the pumps and the condensers. This consists of a cast-iron wheel, nine feet in diameter, and twelve inches wide with twelve spokes. Between the spokes are fitted grids formed of brass strips built up very much in the form of honeycomb, that is, full of small holes and about four inches deep, the holes being about 0.12 of a square inch in area.

The wheel is surrounded by a cast-iron casing which is divided vertically into two portions, which form the delivery and discharge chambers. The vertical partition is wide enough to cover the space between two adjacent spokes of the wheel. The casing has four pipes connected to it, inlet and outlet pipes on the delivery side, and the same on the discharge side.

The water enters the strainer by the inlet pipe on the delivery side, passes through half of the grids in the wheel and deposits on them everything that will not pass through the holes. It then leaves by the outlet pipe on the delivery side. After passing through the condensers it re-enters the strainer by the inlet pipe on the discharge side, passes through the other half of the grids, but in an opposite direction and finally leaves the strainer by the outlet pipe on the discharge side. The wheel is rotated slowly and the discharge water washes off from the grids everything that had been deposited on them on the delivery side, and carries it back to the sewer. The idea of the discharge water cleansing the grids is extremely ingenious. The leakage of water from the inlet chamber to the outlet chamber is considerable. It has only been possible to measure this with one pump in use, the quantity being from ten to twelve per cent of the total. Probably this amount will not be very much increased with four pumps running, but with a limited quantity of water, this is rather serious. It also means larger pumps and motors and a larger quantity of electricity used for pumping.

The temperature of the water in the sewer averages about sixty degrees Fahrenheit in the winter and seventy degrees Fahrenheit in the summer. As we are prohibited from returning the water to the sewer above ninety degrees Fahrenheit, the range of temperature for condensation is small, and so the quantity of circulating water required per pound of steam condensed is large.

At present only two exhaust-steam turbo-generators have been installed, but there is sufficient steam from the reciprocating engine for two more exhaust turbines, and these will be added as soon as the increase in output requires them.

The turbines are of the Rateau type running at 1,250 revolutions per minute. The guaranteed output of each set is 1,200 kilowatts, about 2,200 amperes, and 560 volts, with 45,600 pounds of steam per hour at a pressure at the inlet to the turbine not exceeding 14.7 pounds per square inch absolute, and at the exhaust 1.3 pounds absolute, say, 27.25 inches vacuum.

This output is easily obtained in everyday work. This means that the exhaust steam from two of the 780-kilowatt reciprocating sets is sufficient to give an output of 1,200 kilowatts from one of the turbo-generators. Live steam is connected to each turbine through a reducing valve in case the supply of exhaust steam at any time should not be sufficient. These machines will give twenty-five per cent overload for a short period.

The rotor of each turbine has eleven wheels with 265 blades on each wheel. The clearance between moving and stationary parts is considerable, and there has not been any indication of stripping.

Besides the usual governor there is an emergency governor which comes into action if the speed exceeds ten per cent of the ordinary running speed, and also acts if the pressure of the lubricating oils falls.

The dynamos were built by Brown Boveri & Company. They are four-pole machines, and are separately excited by a small dynamo at the end of the shaft. Copper brushes are in use on one machine. The commutator of the other machine has been altered to give increased ventilation, and carbon brushes are fitted. There was some little trouble at first with com-

mutation, but this has been overcome, and both machines are now running well, especially the one fitted with carbon brushes. This commutator keeps very cool, being only forty-two degrees Fahrenheit above the temperature of the air after a six hours full-load run. Each commutator has 100 bars giving a pressure of about twenty-two volts per bar.

At first there was a considerable amount of vibration on these machines, but this was caused by the turbine and dynamo shafts not being quite in line, and by the type of flexible coupling employed. Since one machine has been accurately lined and another type of coupling fitted, the vibration on this has entirely ceased.

The exhaust-steam pipes are arranged so that the steam from the reciprocating sets can pass either to the exhaust turbines or direct to two other condensers. As previously mentioned, two other exhaust steam turbines will be installed over these condensers when required.

Automatic atmospheric valves are placed in the exhaust pipes between the reciprocating engines and the turbines. The conditions under which these valves have to work are very severe. They are balanced to open at about three pounds above atmospheric pressure, so they are always nearly in equilibrium, consequently they are apt to chatter and so damage the faces. The valves first supplied were quite unsuitable. Those now in use, however, are working very well, the improvement being due to very strong construction, careful fitting of all moving parts to prevent all backlash, and the use of a special dashpot which admits air freely on the upward movement of the valve, but by means of a non-return valve, only allows it to escape very slowly when the valve is closing. Oil separators of the Blake type are placed in the exhaust pipes between the reciprocating engines and the turbines which extract the greater part of the oil.

The feed water is further treated by the Davis Perrett electrical process for freeing it from oil. The water from the air-pump discharge passes into wooden tanks in which are a number of iron plates spaced about two inches apart. A current of electricity is passed through these tanks with the object of precipitating finely divided oxide of iron. The small globules of oil adhere to the oxide of iron, and so are easily separated from the water. The water from the air-pump discharge passes into wooden tanks in which are a number of iron plates spaced about two inches apart. A current of electricity is passed through these tanks with the object of precipitating finely divided oxide of iron. The small globules of oil adhere to the oxide of iron, and so are easily separated from the water. The treated oily water then passes into filters containing gravel and sand which retain the oil. Automatic arrangements are provided for flushing the filters to clean the sand. The quantity of electricity used in the filter is one kilowatt-hour for every 1,000 gallons of water treated. The makers guarantee that the filtered water will not contain more than one-tenth of a grain of oil per gallon. This is such a minute quantity that it is not easy to measure, but after twelve months steaming the boilers show hardly a trace of oil.

The diagram given herewith shows the general arrangement of the shaft, pipework, condensers, turbines and other plant.

There is not the least difficulty in running the turbo-generators in parallel with the other dynamos. The old dynamos are shunt-wound, and the turbo-generator compound-wound. The whole regulation is done by the switchboard attendant by means of the shunt resistances. The only point to be careful about is to see that steam is not escaping past the atmospheric valves, which would mean waste. In order to prevent this, indicators have been fitted just above the atmospheric valves, and directly any steam passes the valve an electric circuit is closed which rings a bell on the switchboard. The switchboard attendant then puts more load on to the turbine and so reduces the pressure of the steam in the exhaust pipe.

Cost of Plant. — The condensing plant is sufficient to deal with the steam from reciprocating and exhaust turbines of 11,000 kilowatts.

The capital cost is shown in Table I.

The economy caused by the exhaust-steam turbines and condensing plant is shown by the figures in Table II, which gives comparative results for similar periods in 1908 when only reciprocating engines were used without condensation, and in 1910 with exhaust-steam turbines and condensation. In 1908 the price of coal was considerably lower—by twenty cents a long ton—than in 1910, but for the purpose of comparison the 1910 price has been taken for both periods.

TABLE I.

		Per kilowatt
Sewer shaft with four eighteen-inch suction and one twenty-six-inch discharge pipe in roadway.	$28,000	$ 2.50
Circulating water exhaust steam-pipework inside the station and oil-extracting plant	30,000	2.50
Rotary water strainer	10,000	1.00
Four condensers circulating and air pumps	55,000	5.00
	$123,000	$11.00
Two 1,200-kilowatt turbo-generators with switchboard	$69,000	$28.50

In the costs per unit generated for the 1910 figures, the units used by the condensing plant have been deducted. As only three of the boilers are fitted with superheaters the amount of superheat is quite small.

TABLE II.

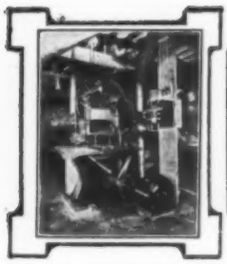
	1908.	1910.
Duration of test	Three weeks	Three weeks
Date	Jan. 16 to Feb. 6	Jan. 20 to Feb. 9
Kilowatt-hours generated	715,491	888,644
Kilowatt-hours used by condensing plant	.....	43,045 = 4.8 percent.
	715,491	845,599
Load factor	22.8 percent.	25.1 percent.
Plant factor	89.6 percent.	76.9 percent.
Pounds of water per kilowatt-hour generated	39 pounds	22.2 pounds
Pounds of water evaporated per pound of coal	6.67 pounds	6.6 pounds
Pounds of coal per kilowatt-hour generated.	5.85 pounds	3.9 pounds
Maximum output	6,227 kilowatts	7,021 kilowatts

COSTS PER UNIT GENERATED.

	Cents.	Cents.	Percentage Saving.
Fuel	0.502	0.334	33.4
Oils and stores	0.018	0.008	50
Water	0.054	0.012	78
Salaries and wages	0.108	0.094	....
Repairs (estimated)	0.114	0.114	....
	0.796	0.562	30

At present at the time of top load in the winter months, three or four reciprocating engines are exhausting direct to the condensers so the economy will be increased when the other two turbines are installed.

The price of the sewer shaft and pipework in the roadway comes to $2.5 per kilowatt. This is considerably less than cooling towers would have cost. In places where a river or other sufficient supply of water is not available for condensation, a main sewer, if near the generating station, is well worth consideration.



Industrial Power

ELECTRIC PUMPING IN HOLLAND.

METHODS ADOPTED IN RECLAMATION WORK AT THE MAAS ESTUARY.

Owing to the diversion of the River Maas, which was completed by the Dutch Government in the year 1905, it became necessary to resort to artificial drainage for the flooded districts of special generating station. The accompanying map (Fig. 1) shows the flooded districts, also the positions of the generating station and the various pumping stations. These latter vary considerably in size and output according to the local conditions in each case. The quantity of water to be raised by the separate pumps varies between 0.3 and 100 cubic meters per minute, while the maximum lift lies between 1.3 and two flooded districts; they are thus only employed during high-water periods, and as they are all in the neighborhood of the generating station, they are operated from the latter point, the pumping machinery being started up and stopped by hand. These three stations, owing to their situation, have to deal with the largest quantity of water. The remaining pumping stations have to be operated automatically

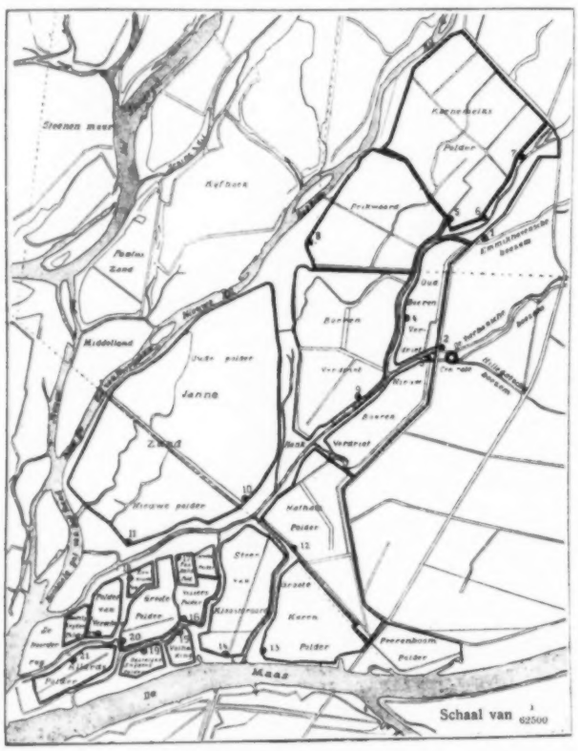


FIG. 1.—MAP OF MAAS ESTUARY DISTRICT, SHOWING PUMPING STATIONS BY NUMBERS.

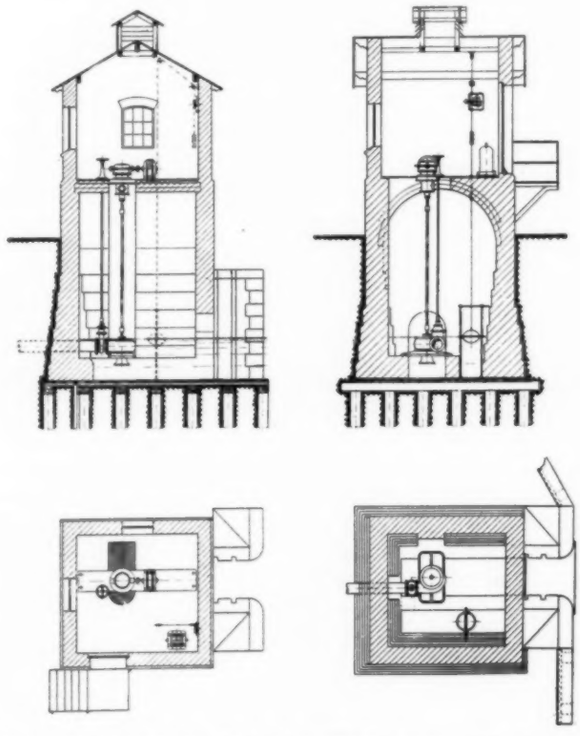


FIG. 2.—VIEWS OF AN ELECTRIC PUMPING STATION IN MAAS ESTUARY DISTRICT.

Emmikhoven, Vierban and Hillegat, also the low-lying grounds in the neighborhood of the rivers Bleek and Oostkil. The carrying out of the drainage scheme was intrusted to the Allgemeine Elektricitäts Gesellschaft, Berlin, Germany.

In order to deal with the large quantities of water it was necessary to erect twenty-two pumping stations, which were fed with electric current from a meters. In the accompanying table the area of the flooded districts served by each pumping station is given, also the quantity of water dealt with, and the maximum lift at each station. Most of these pumping stations lie to the south of the generating station in the low-lying land of the Maas; the remainder are in the neighborhood of the Bleek and Oostkil rivers. Pumping stations 1 to 3 serve for the drainage of the owing to the constantly varying conditions. This automatic operation is carried out by means of a float arrangement, which is dependent upon the water level.

The central station contains two horizontal tandem steam engines which are directly connected to the generators. The latter give an output of 260 kilowatts (three-phase) at a pressure of 3,000 volts. The current is con-

ducted by means of high-tension transmission lines to the separate pumping stations, where it is stepped down to a working pressure of 215 volts by means of transformers. The generating station and pumping stations are connected by a telephone system in order to allow all necessary instructions to be carried out without loss of time.

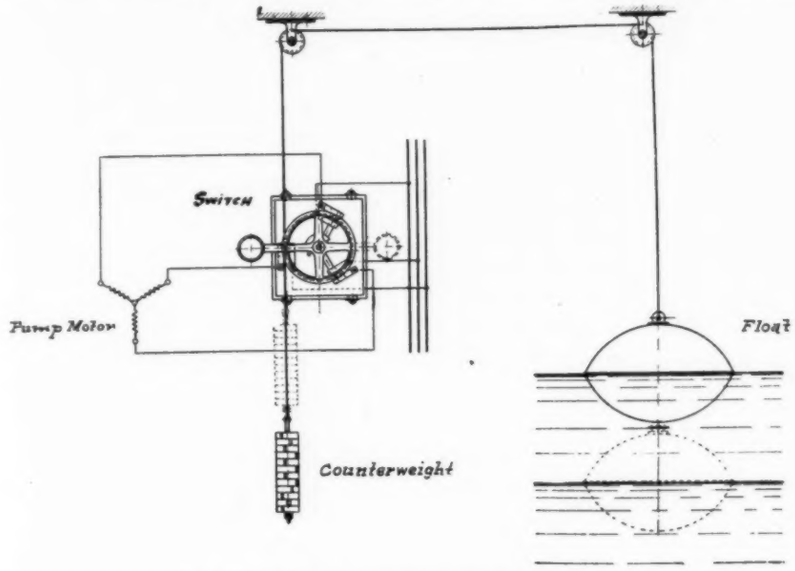


FIG. 3.—DIAGRAM SHOWING FLOAT SWITCH.

The pumps have vertical shafts. The pump runners are arranged below the water level, and the vertical suction pipe, which is placed directly under the pump casing, is immersed to a depth of 0.05 to 0.8 meter below the surface of the water. The motor is erected on the floor of the pumping house at a height of about four meters above the water level.

The transmission of power from the horizontal motor to the vertical shaft of the pump is carried out by means of a rigid coupling in conjunction with a pair of beveled gear wheels running in an oil bath, and having their bearings entirely inclosed by means of a cast-iron case. The side pressure is taken up by means of specially constructed ball bearings. The length of the pressure piping varies at the different stations and is on the average between five and fourteen meters. Only at the pumping stations 1 and 2, where the local conditions alow a siphon arrangement, the pressure piping has a length of approximately twenty-five and thirty meters. In each length of piping a valve is inserted which can be operated from the floor of the pumping house. The outlet piping, which is at an angle of thirty degrees, is provided at its end with an iron flap with rubber packing, in order to prevent the return of the outside water. In order permanently to insure the siphon action at the above-mentioned stations 1 and 2, small air pumps which are started up simultaneously with the water pumps extract all air which has collected at the highest point in the pressure piping. A barometric tube ten meters in height insures the safety of the air pumps against water hammer.

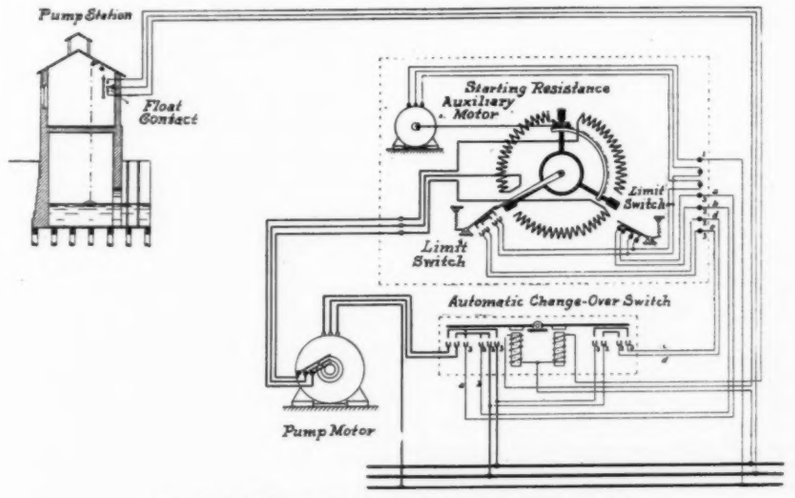


FIG. 4.—DIAGRAM SHOWING MOTOR CONNECTIONS.

All motors with an output of less than five horsepower have short-circuited rotors, while all those with higher outputs, namely, in every case in which the operation is automatic, are provided with regulating slip-ring rotors and automatic starting resistances. The motors for the pumping stations 1 to 3, which, as previously mentioned, are switched in by hand, have slip-rings with short-circuiting devices and liquid starting resistances.

Pumping Station No. The Nos. are reproduced in Fig. 1.	Area of the low-lying lands and flooded districts Hectares.	Quantity of Water to be raised, in cubic meters per min.	Theoretical maximum Lift
1	400	21.65	2.00
2	1700	91.80	2.00
3	850	45.90	1.60
4	50	2.70	1.80
5	170	9.20	1.75
6	5	0.30	1.70
7	7	0.40	1.45
8	90	4.90	1.40
9	130	7.05	1.55
10	190	10.30	1.70
11	140	7.60	1.75
12	80	4.35	1.60
13	70	3.80	1.70
14	70	3.80	1.70
15	15	0.85	1.55
16	20	1.10	1.75
17	8	0.45	1.30
18	8	0.45	1.65
19	15	0.85	1.65
20	30	1.65	1.75
21	25	1.35	1.90
22	21	1.15	1.85

The operation of the pumping stations 4 to 22, for which the existing conditions make it essential to employ automatic working, is carried out in the simple manner shown in Figs. 3 and 4, with the assistance of automatic float switchgear. The arrangements are such that the pumps begin to work when the water level is 0.2 of a meter above the summer water level, and are cut out as soon as the water has fallen 0.2 of a meter below this point.

The float, the position of which is dependent upon the internal water level, operates a switch in both its end positions (see Fig. 3, on the left). This switch in turn directly operates the small motors with short-circuited ro-

tors, the larger slip-ring motors being started up and stopped by means of a starting resistance and auxiliary motor (see Fig. 4). The pumping stations at the Maas Estuary work entirely automatically, the only attention they require being an occasional revision of the running parts and the lubrication of the same.

Automatic switchgear arrangements similar to those above described have been used in recent years by the Allgemeine Elektricitäts Gesellschaft under very varying conditions. They have always proved very reliable and have been entirely free from breakdowns.

The Faraday Society.

At a meeting of the Faraday Society, London, on May 31, J. W. Hinchley read a paper entitled "Some Practical Experience of the Sherardizing Process."

The sherardizing process (a method of dry galvanizing in which iron or steel articles are coated with zinc by being heated in closed receptacles with zinc dust) is of great interest on account of the fact that no adequate scientific explanation has appeared. It was discovered by Sherard Cowper-Coles about eight years ago, and has been worked commercially for the past seven years. The general theory given by the inventor that the zinc vaporizes from the zinc dust and is condensed on the articles is in complete antagonism with the commercial practice of the process. The successful conduct of the process depends mainly on the percentage of metallic zinc in the zinc dust being kept at a suitable figure, while the limits of temperature and time required are comparatively wide. The best mixture of zinc dust for jobbing work contains about eighteen per cent of metallic zinc. Sherardizing begins at a temperature just above that required to produce a film of magnetic oxide of iron on the article. In all cases the deposit of zinc contains iron, and the conclusion is drawn that the interaction of the film of magnetic oxide of iron and the zinc dust determines the deposition of zinc. No deposit can be obtained from the vapor of zinc at any sherardizing temperature, i. e., at any temperature below the melting-point of zinc. At temperatures higher than this the deposit is not in any way comparable with a sherardizing coating, and is useless. At 250 degrees centigrade a temperature usually not much exceeded in best work, the vapor tension of zinc is not likely to be greater than that of mercury at zero degrees, i. e., one two-thousandths millimeter mercury—a pressure quite incapable of depositing one ounce of zinc per square foot of surface in less then an hour. The process is essentially a contact process; a film of magnetic oxide of iron is first formed and then reduced to metallic iron by contact with the metallic zinc in the zinc dust, forming a film of solid solution of iron in zinc as closely adherent to the iron as the original magnetic oxide film. If the amount of metallic zinc in the zinc dust be insufficient, a black film of reduced iron is formed. The deposit resists corrosive agents much better than pure zinc on account of the potential difference between it and metallic iron being less than between pure zinc and iron. As a protective agent against atmospheric corrosion the deposit is most remarkable. After the slight yellowish powder which is first formed has been washed off by the rain the surface gradually becomes black and practically permanent. Chain blocks treated by the process have been in use in the open air for seven years, and are now free from rust and apart from the result of daily wear as good as new. In England a dearth of enterprise on the part of manufacturers has led to the existence of jobbing factories only. In America many firms making specialties have adopted the process in their own factories, and the daily output is greater there than the quarterly output in England.

The chairman asked whether the process had been used for materials other then iron and steel. He believed it was unsuitable for aluminum. Did it affect the tensile strength of materials treated? In view of the extent to which it was used in America, it was surprising that it had not been more largely adopted in England.

J. W. Hinchley, in reply, said the process so far was only practical or useful in the case of iron and steel. Tensile strengths due to mechanical working (drawing or rolling) were removed by the process, but sherardized wire could be drawn. In all cases where there are irregular stresses, the tensile strength is increased, and the process will find out flaws. Zinc deposits could only be obtained from vapor near the boiling point of the metal. The fact that no coating will take until a film of magnetic oxide formed on iron or steel confirmed him in his belief in the contact theory.

C. V. Biggs and W. Pollard Digby exhibited and gave a short demonstration of:

(1) Apparatus for the Rapid Determination of the Resistance of Liquids.

(2) Apparatus for the Determination of the Specific Resistance of Oil.

The former apparatus consists of a megger furnished with a scale reading reciprocal megohms, used in conjunction with a glass U-tube to contain the liquid under examination. Polarization is minimized by the use of annular platinum electrodes and by having the tube very long compared with its sectional area, the voltage employed being about 250. A reading is obtained in a few seconds. The apparatus is particularly suitable for checking the purity of the water supply for boilers, for controlling the softening of hard water, and for similar engineering purposes, as well as for scientific investigations.

The apparatus for measuring the resistance of oil consists of two parallel metal disks of 100 square centimeters area, insulated from one another. These are separated by a micrometer head to a distance of about 100 mils, immersed in the oil, and then connected to a megger and a reading taken. The mean specific resistance is calculated as the mean of a series of readings.

Many Electrical Projects on Foot in Russia.

Consul-General John H. Snodgrass, of Moscow, supplies the following news concerning the great energy now manifest in developing Russian cities:

Elektritchestvo is authority for the statement that new electrical stations are contemplated for Novgorod, Kupy-Roono, in the Government of Volhynia, and Karassubarar in the Government of Tabriz, Alexandroosk-Gruschersk, and Kharbin. The town of Tambov had a proposition submitted by a German firm for electric lighting which would include a hydraulic power station. Poltava is advertising for a supplementary dynamo and engine. The following electric undertakings are either decided upon or are being projected:

Hennitchesk, electric lighting; Kiev, extension of electric lighting; Tchernigoff, telephone system; Orgieff, electric lighting; Rostov-on-the-Don, power station; Simferopol, electric tramways; Abashukino (in the Caucasus), hydro-electric station; Vladivostok, central power station; Novo-Nikolaievsk, electric lighting; Minsk, electric traction for tramways; Tiflis, electric railway along Mount St. David, and several other works in the district; Piatigorsk, electric power station; Romaninsk (Caucasian oil fields), power station; Poltava, electric tramways.

The *Journal de St. Petersburg* states that the Central Telephone Administration has obtained permission from the municipal authorities to use $1,420,000 in extending the telephone system and enlarging the central exchange so as eventually to serve 34,000 subscribers. The administration desires to arrange for an eventual 45,000 subscribers, and has asked that the amount be increased to $2,425,000.

If Moscow can secure a loan of $12,360,000, the town council will expend the following sums on public improvements: $5,250,000 for extending the street car lines and taking over several private lines not yet electrified, $1,300,000 for drainage and canalization works, $2,000,000 for reconstruction of municipal gas works, and about $1,000,000 for enlargement of the municipal slaughterhouses. All these improvements, however, must be carried out by home industry, if possible, in accordance with the Government's order.

Registration List at American Institute Convention.

The folowing members and guests attended the convention: Mr. and Mrs. Comfort A. Adams, Cambridge, Mass.; E. W. Allen, Schenectady, N. Y.; A. H. Armstrong, Schenectady, N. Y.; Mr. and Mrs. H. B. Alverson, Buffalo, N. Y.; W. K. Archbold, Syracuse, N. Y.; Harry Barker, New York City; H. H. Barnes, Jr., New York City; Mr. and Mrs. Philip P. Barton, Niagara Falls, N. Y.; A. W. Berresford, Milwaukee, Wis.; S. H. Blake, Pittsfield, Mass.; F. A. Bower, Sea Cliff, N. Y.; J. M. Bryant, Urbana, Ill.; J. T. Butterfield, Walpole, N. H.; Mr. and Mrs. M. C. Beebe, Madison, Wis.; E. P. Burch, Minneapolis, Minn.; A. F. Batcheldor, Schenectady, N. Y.; Mr. and Mrs. R. H. Carlton, Schenectady, N. Y.; W. G. Carlton, Yonkers, N. Y.; Mr. and Mrs. G. N. Chamberlain, Swampscott, Mass.; Mr. and Mrs. A. R. Cheyney, Philadelphia, Pa.; F. P. Coffin, Schenectady, N. Y.; Wm. W. Crawford, New York City; E. E. F. Creighton, Schenectady, N. Y.; T. E. Crossman, New York City; Edward Caldwell, New York City; M. de Chatelain, St. Petersburg, Russia; Mr. and Mrs. F. E. Donohoe, New York City; W. I. Donshea, Brooklyn, N. Y.; A. C. Dunham, Hartford, Conn.; Miss M. E. Durant, Elizabeth, N. J.; Henry B. Dates, Cleveland, O.; Gano Dunn, Ampere, N. J.; Mr. and Mrs. M. O. Dell Plain, Schenectady, N. Y.; Mrs. A. Elmendorf, Jersey City, N. J.; G. M. Eaton, Pittsburg, Pa.; O. J. Ferguson, Schenectady, N. Y.; W. J. Foster, Schenectady, N. Y.; J. J. Frank, Pittsfield, N. Y.; John H. Finney, Washington, D. C.; Mr. and Mrs. F. G. Gasche, Chicago, Ill.; Geo. G. Grower, Ansonia, Conn.; Antonio Guell, Urbana, Ill.; Mr. and Mrs. C. A. B. Halverson, Lynn, Mass.; C. Francis Harding, LaFayette, Ind.; Mr. and Mrs. F. W. Harris, Pittsburg, Pa.; H. E. Hartwell, Worcester, Mass.; J. L. R. Hayden, Schenectady, N. Y.; W. A. Hillebrand, Palo Alto, Cal.; Mr. and Mrs. Geo. A. Hoadley, Swarthmore, Pa.; Cyril J. Hopkins, Philadelphia, Pa.; Hall F. Hoxie, Ridgewood, N. J.; F. L. Hutchinson, New York City; Mr. and Mrs. G. H. Hill, Schenectady, N. Y.; Wm. B. Hale, Mexico City, Mexico; L. E. Imlay, Niagara Falls, N. Y.; Mr. and Mrs. P. Junkersfeld, Chicago, Ill.; Mr. and Mrs. Dugald C. Jackson, Boston, Mass.; Miss Jackson, Boston, Mass.; Mr. and Mrs. V. Karapetoff, Ithaca, N. Y.; A. E. Kennelly, Cambridge, Mass.; Mr. and Mrs. J. B. Klumpp, Philadelphia, Pa.; Mr. and Mrs. Chas. D. Knight, Schenectady, N. Y.; Mr. and Mrs. August H. Kruesi, Schenectady, N. Y.; A. S. Langsdorf, St. Louis, Mo.; A. H. Lawton, New York City; W. L. Lee, Charlotte, N. C.; Harold B. Lewry, Brooklyn, N. Y.; Mr. and Mrs. J. C. Lincoln, Cleveland, O.; Morton G. Lloyd, Chicago, Ill.; Mr. and Mrs. Arthur B. Lisle, Providence, R. I.; Edward N. Lake, Chicago, Ill.; Mr. and Mrs. Wm. Maver, Jr., New York City; Miss E. Maver, New York City; Alexander Maxwell, New York City; H. Maxwell, Schenectady, N. Y.; A. S. McAllister, New York City; Mrs. I. McKinnon, New York City; W. L. Merrill, Schenectady, N. Y.; Ralph D. Mershon, New York City; A. A. Miller, Seattle, Wash.; Mr. and Mrs. C. T. Mosman, Boston, Mass; E. C. Morse, Boston, Mass.; E. C. Morse, Boston, Mass.; Wm. McClellan, New York City; Floyd A. Norris, Brooklyn, N. Y.; E. L. Nichols, Ithaca, N. Y.; H. L. Osborne, Cambridge, Mass.; Mr. and Mrs. Farley Osgood, Newark, N. J.; David Paton, Lakewood, N. J.; Mr. and Mrs. Ralph W. Pope, New York City; W. H. Powell, Milwaukee, Wis.; H. St. C. Putnam, New York City; Mr. and Mrs. W. H. Pratt, Lynn, Mass.; W. L. Robb, Troy, N. Y.; L. T. Robinson, Schenectady, N. Y.; W. E. Rundle, East Orange, N. J.; David P. Rushmore, Schenectady, N. Y.; Edgar W. Reed, Pittsburg, Pa.; M. P. Rice, Schenectady, N. Y.; Mr. and Mrs. G. A. Sawin, Newark, N. J.; Mr. and Mrs. C. F. Scott, Pittsburg, Pa.; Geo. F. Sever, New York City; Adolph Shane, Ames, Ia.; Mr. and Mrs. W. I. Schlichter, Schenectady, N. Y.; Frank S. Smith, New York City; Paul Spencer, Philadelphia, Pa.; Mr. and Mrs. Frank J. Sprague, Sharon, Conn.; Mr. and Mrs. S. D. Sprong, Brooklyn, N. Y.; H. B. Stabler, Washington, D. C.; Chas. P. Steinmetz, Schenectady, N. Y.; Geo. H. Stickney, Schenectady, N. Y.; Mr. and Mrs. Lewis B. Stillwell, Lakewood, N. J.; Richard Stillwell, Lakewood, N. J.; Mr. and Mrs. C. W. Stone, Schenectady, N. Y.; P. W. Sothman, Toronto, Ont.; N. W. Storer, Pittsburg, Pa.; Arthur B. Smith, Chicago, Ill.; Mr. and Mrs. W. C. Stevens, Woodstock, Vt.; Clayton H. Sharp, New York City; Mr. and Mrs. John B. Taylor, Schenectady, N. Y.; L. H. Thullen, Cincinnati, Ohio; Mr. and Mrs. H. W. Tobey, Pittsfield, Mass.; J. F. Tritle, Schenectady, N. Y.; R. G. Tintchell, Boston, Mass.; Percy H. Thomas, New York City; Arthur Tyng, Boston, Mass.; Walter L. Upson, Columbus, O.; Geo. S. Vail, Cleveland, O.; H. H. Van Staagen, Boston, Mass.; J. F. Vaughan, Boston, Mass.; E. A. Wagner, Fort Wayne, Ind.; Henry R. Wakeman, Portland, Ore.; J. M. Wakeman, New York City; H. L. Wallau, Cleveland, O.; J. B. Whitehead, Baltimore, Md.; Hugh M. Wilson, New York City; R. L. Witham, Lisbon Falls, Me.; Harry P. Wood, Atlanta, Ga.; Mr. and Mrs. J. H. Wilson, Berlin, N. H.; Geo. H. Whitefield, Richmond, Va.; C. M. Yale, Hartford, Conn.

Pittsburg Electric Boosters' Club.

At the monthly meeting of the Pittsburg Eletric Boosters' Club, held May 27, at the Duquesne Hotel, approximately seventy-five men were present. The meeting was preceded by the customary dinner. Following this, E. P. Warner, one of the senior representatives of the Western Electric Company addressed the club informally in a most interesting manner. W. A. Wynne, general manager of the Raleigh Telephone Company, Raleigh, N. C., followed with a humorous speech. The paper of the evening was by C. E. Clewell, of the Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa., on "Factory Lighting," and was of particular interest. An abstract of this paper will be given in a later issue.

Third Avenue Line Will Pay Debt.

Receiver Whitridge, of the Third Avenue Railway System, recently announced that he had already paid off $500,000 worth of receiver's certificates and before the end of the present year expected to pay another $500,000 worth.

When Mr. Whitridge began to lift the debt of the receivership period, $3,500,000 stood on the debit side of the ledger, $1,000,000 of which went to pay up the back franchise tax and the remainder for cars, new buildings, the establishment of a beneficiary association for employés and other betterments.

If the reorganization plan goes into effect a first-class street railroad will fall into the hands of the new operators.

The History of the Telephone.

The Telephone and the Telephone System—I.

BY HERBERT N. CASSON.

Four wire-using businesses were already in the field when the telephone was born—the fire alarm, burglar alarm, telegraph and messenger-boy service, and at first, as might have been expected, the humble little telephone huddled in with these businesses as a sort of a poor relation. To the general public, it was a mere scientific toy, but there were a few men, not many, in these wire-stringing trades, who saw a glimmering chance of creating a telephone business. They put telephones on the wires that were then in use. As these became popular, they added others. Each of their customers wished to be able to talk to everyone else. And so, having undertaken to give telephone service, they presently found themselves battling with the most intricate and baffling engineering problem of modern times—the construction around the telephone of such a mechanism as would bring it into universal service.

ALEXANDER GRAHAM BELL.

The first of these men was Thomas A. Watson, the young mechanic who had been hired as Bell's helper. He began a work that today requires an army of 26,000 people. He was for a couple of years the total engineering and manufacturing department of the telephone business, and by 1880 had taken out sixty patents for his own suggestions. It was Watson who took the telephone as Bell had made it, really a toy, with its diaphragm so delicate that a warm breath would put it out of order, and toughened it into a more rugged machine. Bell had used a disk of fragile gold-beaters' skin with a patch of sheet-iron glued to the center. He could not believe, for a time, that a disk of all-iron would vibrate under the slight influence of a spoken word. But he and Watson noticed that when the patch was bigger the talking was better, and presently they threw away the gold-beaters' skin and used the iron alone.

Also, it was Watson who spent months experimenting with all sorts and sizes of iron disks, so as to get the one that would best convey the sound. If the iron were too thick, he discovered, the voice was shrilled into a Punch-and-Judy squeal; and if it were too thin, the voice became a hollow and sepulchral groan, as though the speaker had his head in a barrel. Other months, too, were spent in finding out the proper size and shape for the air cavity in front of the disk. And so, after the telephone had been perfected in principle, a full year was required to lift it out of the class of scientific toys, and another year or two to properly present it to the business world.

Until 1878 all Bell telephones were made by Watson in Charles Williams' little shop in Court Street, Boston—a building long since transformed into a five cent theater. But the business soon grew too big for the shop. Orders fell five weeks behind. Agents stormed and fretted. Some action had to be taken quickly, so four other manufacturers were given licenses to make telephone apparatus. By this time the Western Electric Company of Chicago had begun to make the infringing Gray-Edison telephones for the Western Union, so that there were soon six groups of mechanics puzzling their wits over the building of telephones and switchboards.

THOMAS A. WATSON.

By 1880 there was plenty of telephonic apparatus being made, but in too many different varieties. Not all the summer gowns of that year presented more styles and fancies. The next step, if there were to be any degree of uniformity, was plainly to buy and consolidate these six companies; and by 1881 Vail had done this. It was the first merger in telephone history. It was a step of immense importance. Had it not been taken, the telephone business would have been torn into fragments by the civil wars between rival inventors.

From this time the Western Electric became the headquarters of telephonic apparatus. It was the Big Shop. All roads led to it. No matter where a new idea was born, sooner or later it came knocking at the door of the Western Electric to be given a material body. Here were the skilled workmen who became the Hands of the telephone business. And here, too, were many of the ablest inventors and engineers, who did most to develop the cables and switchboards of today.

THOMAS A. EDISON.

In Boston, Watson had resigned in 1882, and in his place stood a timely new arrival named E. T. Gilliland. This really notable man was a friend in need to the telephone. He had been a manufacturer of electrical apparatus in Indianapolis, until Vail's policy of consolidation had drawn him into the central group of pioneers and pathfinders. For five years Gilliland led the way as a developer of better and cheaper equipment. He made the best of a most difficult situation. He was so handy, so resourceful, that he invariably found a way to unravel the mechanical tangles that perplexed the first telephone agents, and this, too, without compelling them to spend large sums of capital. He took the ideas and apparatus that were then in existence, and used them to carry the telephone business through the most critical period of its life, when there was little time or money to risk on experiments. He took the peg switchboard of the telegraph, for instance, and developed it to its highest point, to a point that was not even imagined possible by anyone else. It was the most practical and complete switchboard of

its day, and held the field against all comers until it was replaced by the modern type of board, vastly more elaborate and expensive.

By 1884, gathered around Gilliland in Boston and the Western Electric in Chicago, there came to be a group of mechanics and High School graduates, very young men, mostly, who had no reputations to lose; and who, partly for a living and mainly for a lark, plunged into the difficulties of this new business that had at that time little history and less prestige. These young adventurers, most of whom are still alive, became the makers of industrial history. They were unquestionably the founders of the present science of telephone engineering.

E. T. GILLILAND

The problem that they dashed at so light-heartedly was much larger than any of them imagined. It was a Gibraltar of impossibilities. It was on the face of it a fantastic nightmare of a task—to weave such a web of wires, with interlocking centers, as would put any one telephone in touch with every other. There was no help for them in books or colleges. Watson, who had acquired a little knowledge, had become a ship-builder. Electrical engineering, as a profession, was unborn. And as for their telegraphic experience, while it certainly helped them for a time, it started them in the wrong direction and led them to do many things which had afterwards to be undone.

The peculiar electric current that these young path-finders had to deal with, is perhaps the quickest, feeblest and most elusive force in the world. It is so amazing a thing that any description of it seems irrational. It is as gentle as the touch of a baby sunbeam, and as swift as the lightning flash. It is so small that the electric current of a single incandescent lamp is greater—500,000,000 times. Cool a spoonful of hot water just one degree, and the energy set free by the cooling will operate a telephone for ten thousand years. Catch the falling tear-drop of a child, and there will be sufficient water-power to carry a spoken message from one city to another.

Such is the tiny Genie of the Wire that had to be protected and trained into obedience. It was the most defenseless of all electric sprites, and it had so many enemies. Enemies! The world was populous with its enemies. There was the lightning, its elder brother, striking at it with murderous blows. There were the telegraphic and light-and-power currents, its strong and malicious cousins, chasing and assaulting it whenever it ventured too near. There were rain and sleet and snow and every sort of moisture, laying in wait to abduct it. There were rivers and trees and flecks of dust. It seemed as though all the known and unknown agencies of Nature were in a conspiracy to thwart or annihilate this gentle little messenger who had been conjured into life by the wizardry of Alexander Graham Bell.

All that these young men had received from Bell and Watson was that part of the telephone that we call the "receiver." This was practically the sum total of Bell's invention, and remains today as he made it. It was then, and is yet, the most sensitive instrument that has ever been put to general use in any country. It opened up a new world of sound. It would echo the tramp of a fly that walked across a table, or repeat in New Orleans the prattle of a child in New York. This was what the young men received, and this was all. There were no switchboards of any account, no cables of any value, no wires that were in any sense adequate, no theory of tests or signals, no exchanges, *no telephone system of any sort whatever.*

As for Bell's first telephone lines, they were as simple as clothes lines. Each short little wire stood by itself, with one instrument at each end. There were no operators, switchboards nor exchanges. But there had now come a time when more than two people wanted to be in the same conversational group. This was a larger use of the telephone; and while Bell himself had foreseen it, he had not worked out a plan whereby it could be carried out. Here was the new problem, and a most stupendous one—how to link together three telephones, or three hundred, or three thousand, or three million, so that any two of them could be joined at a moment's notice.

And this was not all. These young men had not only to battle against mystery and "the powers of the air." They had not only to protect their tiny electric messenger and to create a system of wire highways along which he could run up and down safely. They had to do more than this. They had to make this system so simple and fool-proof that everyone—everyone except the deaf and dumb—could use it without any previous experience. They had to educate Bell's Genie of the Wire so that he would not only obey his masters, but anybody—anybody who could speak to him in any language.

No doubt if the young men had stopped to consider their life-work as a whole, some of them might have turned back. But they had no time to philosophize. They were like the boy who learns how to swim by being pushed into deep water. Once the telephone business was started, it had to be kept going, and as it grew, there came one after another a series of congestions. Two courses were open—either the business had to be kept down to fit the apparatus, or the apparatus had to be developed to keep pace with the business. The telephone men, most of them, at least, chose development; and the brilliant inventions that afterwards made some of them famous were compelled by sheer necessity and desperation.

The first notable improvement upon Bell's invention was the making of the TRANSMITTER in 1877 by Emile Berliner. This, too, was a romance. Berliner, as a poor German youth of nineteen, had landed at Castle Garden in 1870 to seek his fortune. He was given a job as "a sort of bottle-washer at $6 a week," he says, in a chemical shop in New York. At nights he studied science in the free classes of Cooper Union. Then a druggist named Engel gave him a copy of Miller's book on physics, which was precisely the stimulus needed by his creative brain. In 1876 he was fascinated by the telephone, and set out to construct one on a different plan. Several months later he had succeeded and was overjoyed to receive his first patent for a telephone transmitter. He had by this time climbed up from his bottle-washing to be a clerk in a drygoods store in Washington; but he was still poor and as unpractical as most inventors. Jo-

EMILE BERLINER.

seph Henry, the Sage of the American scientific world, was his friend, though too old to give him any help. Consequently, when Edison, two weeks later, also invented a transmitter, the prior claim of Berliner was for a time wholly ignored. Later the Bell Company bought Berliner's patent and took up his side of the case. There was a seemingly endless succession of delays—fourteen years of the most vexatious delays, until finally the Supreme Court of the United States ruled that Berliner, and not Edison, had been the original inventor of the transmitter.

DAVID E. HUGHES.

From first to last, the transmitter has been the product of several minds. Its basic idea is the varying of the electric current by varying the pressure between two points. Bell unquestionably suggested it in his famous patent, when he wrote of "increasing and diminishing the resistance." Berliner was the first to actually construct one. Edison greatly improved it by using soft carbon instead of a steel point. A Welsh professor, David E. Hughes, started a new line of development by adapting a Bell telephone into a "microphone"—a fantastic little instrument that would detect the noise made by a fly in walking across a table. Francis Blake, of Boston, changed a microphone into a practical transmitter. Rev. Henry Hunnings, an English clergyman, hit upon the happy idea of using carbon in the form of small granules. And one of the Bell experts named White improved the Hunnings transmitter into its present shape. Both transmitter and receiver seem now to be as complete an artificial tongue and ear as human ingenuity can make them. They have persistently grown more elaborate until today a telephone set, as it stands on a desk, contains as many as 130 separate pieces, as well as a salt-spoon full of glistening granules of carbon.

Next came the problem of the MYSTERIOUS NOISES. This was, perhaps, the most wierd and mystifying of all the telephone problems. The fact was that the telephone had brought within hearing distance a new wonder-world of sound. All wires at that time were single, and ran into the earth at each end, making what was called a "grounded circuit." And this connection with the earth, which is really a big magnet, caused all manner of strange and uncouth noises on the telephone wires.

Noises! Such a jangle of meaningless noises had never been heard by human ears. There was sputtering and bubbling, jerking and rasping, whistling and screaming. There were the rustling of leaves, the croaking of frogs, the hissing of steam, and the flapping of birds' wings. There were clicks from telegraph wires, scraps of talk from other telephones, and curious little squeals that were unlike any known sound. The lines running east and west were noisier than the lines running north and south. The night was noisier than the day, and at the ghostly hour of midnight, for what strange reason no one knows, the babel was at its height. Watson, who had a fanciful mind, suggested that perhaps these sounds were signals from the inhabitants of Mars or some other sociable planet. And the other more matter-of-fact young telephonists agreed to lay the blame on "induction"—a hazy word which usually meant the natural meddlesomeness and deviltry of electricity.

But whatever else the Mysterious Noises were, they were a nuisance. The poor little telephone business was plagued almost out of its senses. It was like a dog with a tin can tied to its tail. No matter where it went, it was pursued by this unearthly clatter. "We were ashamed to present our bills," said A. A. Adee, one of the first agents; "for no matter how plainly a man talked into his telephone, his language was apt to sound like Choctaw at the other end of the line."

All manner of devices were solemnly tried to hush the wires, and each one usually proved to be as futile as an incantation. What was to be done? Step by step the telephone men were driven back. They were beaten. There was no way to silence these noises. Reluctantly, they agreed that the only way was to pull up the ends of each wire from the tainted earth, and join them by a second wire. This was the "metallic circuit" idea. It meant an appalling increase in the use of wire. It would compel the rebuilding of the switchboards and the invention of new signal systems. But it was inevitable, and in 1882, while the dispute about it was in full blast, one of the young men quietly slipped it into use on a new line between Boston and Providence. The effect was magical. "At last," said the delighted manager, "we have a perfectly quiet line."

This young man—a small, slim youth who was twenty-two years old and looked younger, was no other than John J. Carty, now the first of telephone engineers and almost the creator of his profession. Three years earlier he had timidly asked for a job as operator in the Boston Exchange, at $5 a week, and had shown such an aptitude for the work that he was soon made one of the Captains, and became, at thirty years of age, a central figure in the development of the art of telephony.

What Carty has done is known by telephone men in all countries; but the story of Carty himself—who he is and why, is new. First of all, he is Irish, pure Irish. His father had left Ireland as a boy in 1825. During the Civil War his father made guns in the city of Cambridge, where young John Joseph was born; and afterwards he made bells for church steeples. He was instinctively a mechanic and proud of his calling. He could tell the weight of a bell from the sound of it. Moses G. Farmer, the electrical inventor, was his friend, and Howe, the creator of the sewing-machine.

J. J. CARTY.

At five years of age, little John J. Carty was taken by his father to the shop where the bells were made, and he was profoundly impressed by the magical strength of a big magnet, that picked up heavy weights as though they were feathers. At the High School his favorite study was physics; and for a time he and another boy named Rolfe, now a distinguished man of science, carried on electrical experiments of their own in the cellar of the Rolfe house. Here they had a "Tom Thumb" telegraph, a telephone which they had ventured to improve, and a hopeless tangle of wires. Whenever they could afford to buy more wires and batteries, they went to a nearby store which supplied electrical apparatus to the professors and students of Harvard. This

store, with its workshop in the rear, seemed to the two boys a veritable wonderland of marvels; and when Carty, as a youth of eighteen, was compelled to leave school because of his bad eyesight, he ran at once and secured the glorious job of being boy-of-all-work in this store of wonders. So, when he became an operator in the Boston telephone exchange, a year later, he had already developed to a remarkable degree his natural genius for telephony.

Since then, Carty and the telephone business have grown up together, he always a little distance in advance. No other man has touched the apparatus of telephony at so many points. He fought down the flimsy clumsy methods, that led from one snarl to another. He found out how to do with wires what Dickens did with words. "Let us do it right, boys, and then we won't have any bad dreams"—this has been his motif. And, as the crown and climax of his work, he mapped out the profession of telephone engineering on the widest and most comprehensive lines.

In Carty, the engineer evolved into the educator. His end of the American Telephone and Telegraph Company became the University of the Telephone. He was himself a student, by disposition, with a special taste for the writings of Faraday, the fore-runner, Tyndall, the expounder, and Spencer, the philosopher. And in 1890 he gathered around him a winnowed group of college graduates—he has sixty of them on his staff today, so that he might bequeath to the telephone an engineering corps of loyal and efficient men.

[EDITOR'S NOTE.—This is the first part of a series of telephone articles by Mr. Casson on the History of the Telephone. Chapter II of "The Telephone and the Telephone System" will be published in the issue of July 16, and will be followed by articles on "The Development of the Telephone Exchange," "The Telephone in Foreign Countries," and "Litigation Over the Telephone," each in two parts.

Examination for Draftsmen.

The United States Civil Service Commission announces an examination on July 27-28, 1910, to secure eligibles from which to make certification to fill a vacancy in the position of topographic draftsman, Coast and Geodetic Survey, Washington, D. C., and vacancies requiring similar qualifications as they may occur in any branch of the service. There will also be an examination at the same time for copyist topographic draftsmen.

Chicago Electric Club.

At the regular meeting of the Chicago Electric Club, held on June 29, the members were entertained by an excellent talk by Dr. J. D. McGowan, on the subject of properly caring for such accidents as are apt to occur in connection with electrical work.

Doctor McGowan, who in connection with his private practice, is surgeon for the Commonwealth Edison Company, is particularly fitted to speak on this subject and his remarks, especially those relative to electric shock, were of much value. After giving a description of the Sylvester method of resuscitation, he laid particular stress on the necessity for persistently continuing artificial respiration, even though the patient showed no signs of recovery. In many cases such long continued efforts result in saving a man who would otherwise never regain consciousness.

Strychnine is of great value in cases of shock, and some of this drug, together with a hypodermic syringe, should be kept in the emergency kit of every power house or central station. The ordinary amount used, the doctor stated, is one-twentieth of a grain, and the injection should be made as soon as possible after the shock.

The effect of the low-voltage shocks suffered by telephone operators, may be attributed largely to nervousness, but there are numerous cases where the patient suffers from hysteria after such a shock and is unable to work for weeks.

Speaking on the subject of electrical burns, Doctor McGowan, mentioned especially the value of keeping air from the injured area, through the application of oil, or even the white of an egg, should that be more convenient. Linseed-oil and lime water is very effective in relieving the pain and boracic acid is also useful.

In the treatment of any case, either of a bad burn or of a patient who has regained consciousness after a shock, encouragement plays an important part. The patient should be made to think that the injury is slight and that his recovery will be rapid. Should he think his case serious, the hysteria which is induced by such injuries will be aggravated.

At the close of the doctor's talk many questions were asked regarding various phases of the process of resuscitation and of the effects of electric shock on the system.

Orders Wires Removed in Brooklyn.

Corporation Counsel Watson, of Brooklyn, N. Y., rendered an opinion on June 24 last that the Edison Electric Illuminating Company of Brooklyn had no franchise in the Thirtieth Ward and the Board of Estimate adopted a resolution instructing Borough President Steers to remove all poles and overhead wires in that particular territory. The company's counsel was also advised that if his client expected to continue furnishing electric current in the Thirtieth Ward the company would have to apply for a franchise.

The opinion of Corporation Counsel Watson was in reply to a complaint made to President Mitchell that the Edison company in erecting poles was destroying the trees in certain avenues in the Thirtieth Ward. At Mr. Mitchell's suggestion, corporation counsel was instructed to find out if the company held a franchise.

Large Electrically-Driven Flour Mill.

The Maple Leaf Milling Company, Ltd., of Ontario, Canada, has placed an order with the Allis-Chalmers Company for the machinery for what, it is claimed, will be the largest and most complete flour mill in America. The mill will be located at Port Colburne, Ontario. The buildings are now under construction and every effort is being put forth to have the machinery placed in time for the mill to begin operations as soon as the grain movement in the Northwest begins.

The electrical machinery, which will be supplied by the Allis-Chalmers Bullock Company, of Montreal, includes transformers aggregating 2,400 kilowatt capacity, motors, switchboards, etc. The Allis-Chalmers Company will have charge of the installation of all the machinery and will turn the mill over to the milling company running.

New Motor Cars for the Long Island Railroad.

The Long Island Railroad has received a number of new all-steel motor cars on its second order of 140, and is receiving deliveries at the rate of four per week. These cars contain the latest devices in the way of improved steel electric motor coaches, and cost about $20,000 each.

ELECTRICAL Advertising *and* Selling

"BLAZING NEW TRAILS!"[1]

BY CHARLES A. PARKER.

In view of the somewhat detailed discussions we have already had on the work to which the central-station advertiser should devote his time and thought, such a thing as using one of our articles on central-station advertising to suggest that there are "new trails" to be "blazed" may seem like a superfluous undertaking. The busy advertiser is quite apt to think that if he successfully follows "old trails" he and everybody else should be quite contented.

Nevertheless there is a good reason for devoting the space at our disposal to the question in hand. By "new trails" do not take us to mean revolutionary methods of advertising. Our title should not suggest that we are about to advise the advertiser to break away from long-tried and successful methods for something new and experimental. We do propose, however, to treat here of the possibility of using advertising as a means to devising new uses for electric current and turning these uses to the profits of the central station; also to call attention to the necessity of spending just at present no small part of the central-station's advertising effort on certain comparatively new or little known electrical devices.

Turning at once to the first of our subject, the first question we are called upon to answer is if it is possible to use advertising to develop new uses of electric current and turn them to the profit of the central station?

In an endeavor to justify this answer, let us first consider what, in a general way, it is that electricity has to offer. It will not take a great deal of reflection to formulate a partial list of the general uses of electricity something like this: (1) Light; (2) Heat; (3) Power; (4) Ventilation; (5) Advertising and Selling, and (6) Medicinal and Surgical.

Surely it stands to reason then, that there must be needs for these things that the central station cannot anticipate, but which advertising along the right lines will bring to light. As a matter of fact, this is no new propaganda that we are proposing. It is suggested by the success certain central stations have had in working along these very lines. Here, for instance, are a few electrical utensils and devices that were suggested in much the way that we advise here: Furnaces for jewelers and dentists, medical sterilizers, bacterial slide heaters, candy heaters, welding machines, etc.

Taking it for granted then that there are such new and profitable trails to be uncovered by advertising, how are we going to do it? To put the matter as briefly and pointedly as possible, we must get the minds of different classes of individuals in a state of interrogation. We must get them asking themselves whether or not electricity can be made available to their uses, whether or not they have some need that electricity would meet better than it is being met at present. Then, when we have them in this questioning state of mind our aim should be to make them come to the central station for the answer. We should invite consultation with a view to making a study of the prospects needs and suggesting, if possible, a way in which they can be met by electricity.

NO SCHEME TO SELL PARTICULAR DEVICES.

At the very outset of a campaign of this sort there is one thing that must be made clear. The advertiser must be convinced that this is no scheme to sell some particular device. That is the thing he will suspect and that will make him a little skeptical at first. You must overcome this and convince him that everything is in perfect good faith, that you have nothing up your sleeve to spring on him when you get a reply.

Do not be afraid to play too strongly on this point. Be perfectly frank. Come right out and say, if necessary, that you don't know whether or not electricity can be adapted to his needs and that if it cannot you most certainly will not make him believe that it can.

Proving to your prospect that there is no trickery in your proposition is one thing, arousing his interest to a point where he is really eager to know whether or not there is some profitable and advantageous use of electricity for him is quite another. Possibly the best way to do it is to show him by actual illustration—such as the candy heaters, medical sterilizers, that we have already mentioned—that what you suggest as possible in his case has really been done in many other instances. This is apt to start him looking around and if he discovers that in one respect or another he needs light, heat, power, etc., and is not getting it electrically, he is apt to ask himself why he is not, and, in all probability he will come to you for the answer.

Advertising of this sort must, of necessity be carried on through the mails, and, in many cases, will have to be practically individual in treatment. Letters supplemented by interesting mail matter will form the most effective medium that can be used. The letters themselves should be made as personal in tone as is possible, even to the extent of being actually dictated, or at least being actually typewritten.

As the campaign progresses and begins to show results, as it most certainly should, news items covering any "new" or "special" uses of electricity should be caused to appear with as much regularity as possible in the newspapers. If this scheme is worked right it should have the effect of inducing those who are hesitating to come forward in answer to your invitations.

Of course, an advertising campaign of this sort is no ordinary thing. It calls for the exercise of considerable ingenuity, persistence and often diplomacy. It might even seem like a very visionary scheme, if the experience of certain central stations did not show the very opposite. Solicitors, too, in the course of the eager searchings for

[1] The ninth of the present series of articles on "Central-Station Advertising," appearing in the second issue of each month.

new business have often found many such possible, but previously unrecognized uses of electricity. This being the case is it not perfectly good logic to say that the central station which, by means of its advertising, comes out and holds itself ready to look into the needs of a man's business—to see if there is not some special way in which he can use profitably electric current is progressive. We speak of a "man's business" because, as a matter of fact, most of these special uses will be found to be industrial or professional.

To make this proposed campaign an unqualified success, it must be headed by a man of breadth of vision, of originality, of initiative power and possessing a thorough understanding of electricity. He must be big enough to see the needs of limitations of a business not his own and must be able to apply the powers of electricity to the exigencies of the case. He must have the power of application rather than invention—a faculty not so rare as it would at first seem. In by far the largest number of cases it will be found that among the central-station's list of electrical devices, some one thing can be found that will exactly fit the needs of the case with perhaps nothing more than the finding of a new title for it.

Finally, as a sort of indirect reward, such a campaign as the one we are suggesting helps to place the company before the public in a favorable light. It is a practical demonstration of the fact that the company is ready to go out of its way to give its patrons good service. It all helps to kill the "grasping corporation" notion and will make friends for the company.

PUSHING NEW OR LITTLE KNOWN DEVICES.

What good are electrical devices or possible use of electricity to the central station if the people who could and would make use of them know little or nothing about them?

The writer has always regarded it as a reflection upon the central station, or rather upon its publicity forces, when he has stood, as he sometimes has, in the showrooms and heard visitor after visitor go the rounds of the exhibits constantly expressing wonder over some device which (although common enough to people acquainted with things electrical) the visitor has never heard of.

If these new or little known electrical devices are going to do their duty toward filling the coffers of the central station to overflowing the central station must adopt a policy of constantly pursuing a campaign of education. It must teach the public that there is such an article, that there is need for the article and that its value far exceeds its cost or the expense of operating it.

Now then—this being the case—the next question is, shall we proceed to make knowledge of this new or little known electrical device common by a general and extensive advertising campaign or shall it be done by "intensive" advertising; i. e., advertising directed to a small but very carefully selected class of individuals? If it has a practically universal use and is comparatively inexpensive, then the thing to do is to push it hard all along the line.

There are two facts which make it advisable to introduce and push new electrical devices among a class of selected individuals before doing so on a general scale. In the first place, there is too much to be done in initiating the ordinary customer in the use of common, every-day electrical devices, such as flat-irons and fans, to spoil it all by continually calling his attention to new, out-of-the-ordinary articles. In the second place, the work will be more successful if the energy of the advertising matter is concentrated upon a few people known to be able to take up with new and more or less expensive articles.

After a very carefully selected list of prospects has been made out, prepare a campaign for them, bearing in mind that a good share of the work must be done by letters made as nearly personal as possible. It does no harm—indeed, quite the opposite—if you play upon their vanity a little by suggesting that you are showing a new device to a select list of patrons and that you would be pleased to have their opinion of it. This sort of thing should prove successful, at least with the women. Whatever advertising matter is used to supplement the letters should be of good quality and refined in tone and appeal, for we must remember the class of people to whom we are going. If the articles we are advertising are at all capable of general distribution, it is well to remember that getting them started with the well-to-do—the people who set the pace for the town—will help a great deal in extending their use among consumers of current in general.

Just at present there are three comparatively new electrical specialties upon which the advertising energy of the central station should be concentrated for some time to come. It is a mistake to overlook them for, thanks to the energy of the manufacturers, they are being widely advertised in the national magazines which will, of course, make the central-station's task that much easier.

SUCTION AND VACUUM CLEANERS.

Not the least important of these articles is the suction or vacuum-cleaning device. The large amount of business that has been done along this line already is sufficient to prove it profitable not only from the standpoint of increasing current consumption, but also from the mere sale of the cleaners.

Certainly when an article is put on the market in which electricity plays so vital a part as in the electric cleaner, the central station that does not endeavor to control its own field is making a serious mistake. The writer would advance it as a general proposition that the central station should control the distribution in its field of any device depending upon electric current for operation. This is necessary to good service. The central station must keep itself in readiness to supply any demand that may be made upon it for current. But how is it going to do this if it has no idea of the factors that must be considered as affecting the load at any particular time?

Still another reason for the central station insisting upon keeping its finger in the pie is the fact that its own interests demand that it protect, as far as possible, its customers from electrical contrivances of questionable merit, or even possessing dangerous qualities, for there are such on the market. In the very cases of which we are speaking—suction and vacuum cleaning devices—it is certain that among the many types being advertised, there must be a large number that are ineffective, dangerous and that will work both the central station and its patrons harm. This is, of course, to be taken as no reflection upon an equally large number of prominent makes which are admirably and effectively constructed.

In advertising, there is a psychological moment that like "the tide in the affairs of men which taken at the flood leads on to victory" must be seized upon and turned to profit before it flies

never to return. In the case of suction and vacuum cleaning devices, that moment is here now. This does not mean that in a short time vacuum cleaning is going to fall into disuse; that it is merely a passing fad.

No; vacuum cleaning is here to stay, but the time to make a big thing of it is now. People are interested in absolutely sanitary cleanliness more than they have ever been before. They are out with a big stick after the White Plague and other kindred evils that find prosperity in dirt and dust. Anything that will assist in the campaign interests them and it is no difficult matter to talk vacuum or suction cleaner.

Of course, it is entirely outside the province of this article to say anything regarding the types of cleaners which the central station should push, but this much, however, is quite in point. It would not be good policy for the central station to commit itself forever and a day to any one particular type. There are always other types that are good and certain to have their partisans whose opinions have been crystallized by the manufacturer's advertising. It is the better policy for the central station to be to a certain extent non-committal in pushing cleaners hard, with a view to having their patrons come to them for advice. Then, if the patrons are about to be taken in by some device of uncertain value it will be the duty of the central station to steer them clear of pitfalls and incidentally see that a good cleaner is purchased from the central station itself if that is possible.

The central station should also bear in mind that it cannot commit itself to the stationary idea as against the movable cleaner. They are, in fact, to a large extent non-competing. And both must be given due consideration. Push the stationary idea among people interested in hotels, office buildings, public buildings, large residences about to be constructed, etc. Be no less energetic in promoting the use of movable cleaners among the general consuming public.

Vacuum and suction cleaning, together with the two electrical "specialties" that we still have to consider, offer at present perhaps the best opportunity to the central station to increase its business.

VENTILATING DEVICES.

While the idea of "washed air" in large buildings is common enough, especially in the larger cities, not a great many people realize that practically the same thing can be accomplished in the home by means of a smaller and much less expensive device. And who but the central station is to blame that they do not?

Small ventilating devices are now made by a number of different concerns and certainly offer the advertising departments of central stations throughout the land a very fine opportunity. Here, as in the case of cleaners, agitation against tuberculosis will aid in forwarding their adoption. In fact, the two make a combination that will very often go together in cases where the dollar is of minor consideration.

Best of all, they are not adapted to dwellings alone. The owners of restaurants not large enough to have a big blowing apparatus installed should not be impossible prospects. The same thing ought to hold true of storekeepers, meat dealers, grocers, etc. Many electrical devices have been pushed so hard that a slight cessation might be an advantage, but not so with the small ventilating apparatus. It possesses the very desirable feature of being a comparative novelty, which should aid greatly in attracting attention.

ELECTRIC VEHICLES.

What is the central station doing to forward the use of electrically-propelled vehicles? Now that electric vehicles are coming into their own in all parts of the country this question should be interesting to every progressive central-station advertiser. As current consumers electric vehicle owners are very profitable patrons and the wise advertiser should certainly supplement the efforts of the manufacturers to overcome the prejudice that has hitherto existed against this type of machine. As pleasure vehicles for social purposes, their place is now assured, but even more interesting than this is the fact that they are proving strong favorites for commercial uses. Gimbel Brothers, of New York city, for instance, one of the largest department stores in the country, will use them exclusively for making deliveries when the autumn season opens. Many other concerns are using large electric trucks and testify to the remarkably good service they render. There is no reason whatsoever why the central station should not from now on turn the perfection of the electric vehicles to its own profit.

These, then, are a few of the "trails" that the central-station advertiser has to blaze in his own particular field. We have by no means exhausted the subject, but have simply aimed to give a few pertinent suggestions that may prove of value. The gist of the whole matter is this: There is always something to be done in the field of electrical advertising—always new work to be undertaken. Because electricity is almost synonymous with progress and as long as it is there will constantly be new adaptations of it to meet the manifold needs of mankind.

Antigo Electric Show.

That central stations are realizing the benefits to be derived from local electric shows is evidenced by the frequency with which they are held. A recent and most successful show of this charater was held in Antigo, Wis., for three days, June 15, 16 and 17. It was given under the auspices of the Antigo Electric Company, and for the express purpose of placing before the public the latest appliances in electric lighting, heating, cooking and power lines.

The Masonic Temple (on the lower floor of which the exhibition was held), was decorated with arches and long runs of electric lamps, the outside being made particularly brilliant at night by the runs of outline illumination, which were placed on the front of the building. The general interior illumination was by means of Mazda-tungsten lamps with Holophane reflectors.

Among the exhibitors were the Westinghouse Electric and Manufacturing Company, with a complete line of flat irons, disc stove, toaster-stoves, motors, etc.; the Julius Andrae & Sons Company, Milwaukee, with a general line of heating and cooking appliances, automobile supplies, power pumps, etc.; the Holophane Company, Newark, Ohio, with a line of Holophane reflectors; the Burroughs Adding Machine Company, Detroit, Mich., with electrically operated adding machines; Robertson Manufacturing Company, Cincinnati, Ohio, vacuum cleaners; Electric Fireless Cookstove Company, Hasting, Mich., electric cookstoves. This company had a demonstrator in attendance during the three days of the show. Richard Healy, Jr., with a complete line of electric fixtures. The

Antigo Telephone Company also had a booth, with telephne connections.

The show was a very successful one from an advertising point of view and resulted in a great number of flat irons and heating devices being sold. It was also successful from a solicitator's point of view as it awakened quite an interest in electric illumination and gave people ideas along this line, which has resulted in securing quite a number of orders for house wiring since the show.

American Society for Testing Materials.

The thirteenth annual meeting of the Society was held at the Hotel Traymore, Atlantic City, June 28 to July 2. The members were confronted with a very long programme, and many of the papers had to be presented by title only. No definite reports, other than progress, were received from the Committees on Standard Specifications for Hard-Drawn Copper Wire, Standard Tests of Insulating Materials, Standard Specifications for Coal, and on Magnetic Testing of Iron and Steel. The chairman of the latter committee has resigned, and Dr. Chas. W. Burrows was designated to fill the vacancy. This committee has planned an active campaign, and the next year will be spent in examining methods of testing, leaving the subject of standard specifications for the future.

The first session on Tuesday, June 28, was devoted partly to business. Henry M. Howe was elected president and Edgar Marburg continued in the office of secretary.

On the following days papers were presented upon a variety of subjects. Some of these, which were of interest to electrical engineers, were "Test of a Structural Steel Plate Partly Fused by Shortcircuited Electric Current," by A. W. Carpenter; "Comparative Tests of Lime Mortar, etc.," by E. W. Lazell; "Another Solubility Test on Protective Coatings," and "Classification of Fine Particles According to Size," by G. W. Thompson; "Some Exposure Tests of Structural Steel Coatings," by C. H. Chapman; "A Comparison of Magnetic Permeameters," by C. W. Burrows. A fuller report upon these will be given in our next issue.

On Wednesday evening a memorial session was devoted to honoring the memory of Charles B. Dudley, who died last year. Mr. Dudley was a past president of both the American Society and the International Association for Testing Materials. A number of addresses were delivered referring to the different aspects of his work and his influence as a man and a citizen.

On Thursday evening a smoker was given and at the Friday session there was an exhibit of photographs and drawings of test apparatus by the Engineering College of the University of Wisconsin.

Chicago Subway System Nearer to Realization.

By a decision of the Illinois State Supreme Court that was handed down last week, the ability of the city of Chicago to make use of its special traction fund for the construction of a system of traction subways in the downtown district has been reaffirmed. This fund has accrued from the city's share (fifty-five per cent) of the net receipts from the operation of the surface traction systems according to the franchise ordinances of 1907 and subsequent years. It was contended by certain municipal ownership advocates that this fund must be kept intact for the future purchase by the city of the traction properties and that any appropriation from it for subway building was contrary to the ordinances establishing the fund. The test case was finally carried to the Supreme Court, which has decided that the use of the fund or any part of it for subway construction is not inconsistent with its designated use for any traction purposes. It may be used for the purchase, extension or improvement of the traction lines or any part of them. As the subways will undoubtedly extend and improve the traction facilities of the downtown district, their construction from the proceeds of the city traction fund is a legitimate use of that fund.

This decision has revived interest in the matter and the city's special subway engineer, Bion J. Arnold, has announced that he is ready to draw the plans and specifications for a system of any extent, as soon as the city authorities announce definitely what the general scope of that system should be. A great deal of preliminary work has already been done by Mr. Arnold's assistants and those in the city engineer's office, practically all the existing underground piping and conduit network having been surveyed.

It remains now for the city to decide whether the subways shall be single or double deck, how many tracks shall be laid, whether provision shall be made in them for the present elevated railroads, what provision shall be made for piping and cables, and many other features. Mr. Arnold's general views on these points are quite well known. One feature of his plans doubtless will be the building of the roof of the subways first, further excavation and construction work being carried on without disturbance of the street surface.

There is now available in the city's special traction fund over $4,000,000 and it is growing at the rate of over $1,500,000 annually. The two surface traction companies are pledged to provide $5,000,000 toward subway construction. Therefore quite a respectable sum is available for starting the work, which, it is hoped, may be done within less than a year.

Philadelphia Rapid Transit Wage Scale.

The new wage scale of the Philadelphia Rapid Transit went into effect July 1. Under it the pay of the motormen and conductors who have been in the employ of the company since January 1 were raised one cent per hour, from twenty-two to twenty-three cents. About 4,000 men were affected and the annual payroll will be increased about $80,000.

The next raise takes effect July 1, 1911, and is of half a cent per hour for all men who have then been employed one year.

Must Carry Wireless.

Oceangoing vessels carrying more than fifty passengers after July 1, 1911, must be equipped with wireless telegraphic apparatus before being permitted to leave any port in the United States, according to the terms of a Senate bill passed by the House on June 20. An amendment, proposed by Mr. Mann of Illinois, was adopted, requiring such vessels to exchange messages with all shore or ship stations.

Trolley Lines for Constantinople.

The government of Turkey, through its consul general, Reouf Bey, has invited bids for the construction of an extensive system of trolley lines in Constantinople and vicinity. To the successful bidder are offered the franchises of five lines.

New Electrical and Mechanical Apparatus and Appliances.

Bristol-Durand Averaging Instrument for Circular Chart Records.

The Bristol Company, Waterbury, Conn., has for the last twenty years made a specialty of manufacturing automatic recording instruments for pressure, temperature and electricity. As this class of recording instruments using circular charts have come into general use, there has developed a demand for a simple device to quickly determine the average of the record made on such charts, and the integral value for the whole twenty-four hours or for the time covered by the record.

This demand has been filled by the instrument illustrated herewith, which is based upon a fundamental plan as worked out and patented by Prof. W. F. Durand, of Stanford University, and is constructed in accordance with a novel design recently patented by Wm. H. Bristol, president of the Bristol Company.

The instrument can be applied for averaging records of any kind on circular charts having uniform graduations, as, for instance, records of watts, amperes, temperature, pressure, etc. Recording instruments equipped with circular charts are therefore made available for a number of applications for which it was previously thought necessary to use the instruments recording on straight lines or strip record charts. Recording differential-pressure gauges are coming into use for measuring velocities and volumes of liquids, air or gas flowing in mains, and this integrating device will prove of value for quickly obtaining total volumes of flow for any given period of time.

The simple construction of the instrument is shown in the accompanying illustration. A wooden base with a metal socket is provided for supporting and centering the chart. The socket holds a rotatable pin with a vertical slot at the top to receive the bar which carries the integrating tracer point and triangular support. The vertical groove in the rotatable pin allows the integrating wheel to roll on the chart with uniform pressure due to its own weight.

The integrating wheel is six inches in diameter, the rim being graduated into one hundred numbered equal spaces, and is fitted with a vernier, which makes it possible to easily read with the naked eye to one-tenth of one division on the integrating wheel. The wheel is of such large size it is not necessary to supply any counting device for the number of revolutions.

To operate the instrument the thumb and forefinger of one hand are applied to the base of the triangular support, which is moved radially, so as to cause the tracer point to continually follow the record curve, while the chart is turned with the other hand.

By referring to a line plotted on a sheet of cross section paper furnished with the instrument, for the particular record curve that is to be measured, the total reading for the entire twenty-four hours may be taken off directly.

A full explanation of the theory upon which the operation of the instrument depends has been given by Professor Durand, in a paper presented at the New York meeting of the American Society of Mechanical Engineers in 1908. This may be briefly summarized as follows:

In applying the instrument it is necessary to have a uniform radial scale, from which it follows that equal increments in the length of the radius correspond to equal increments in the watts, amperes, temperature or whatever quantity is measured.

The integrating wheel being carried at right angles to shaft passing through the center does not turn and give a reading when the tracing point is moved on a straight radial line, but if the tracing point is made to follow a record, the integrating wheel will revolve and the amount of the revolution will correspond to the total of the circumferential elemental components of the record curve, the radial elemental components of the record having no turning effect whatever on the integrating wheel.

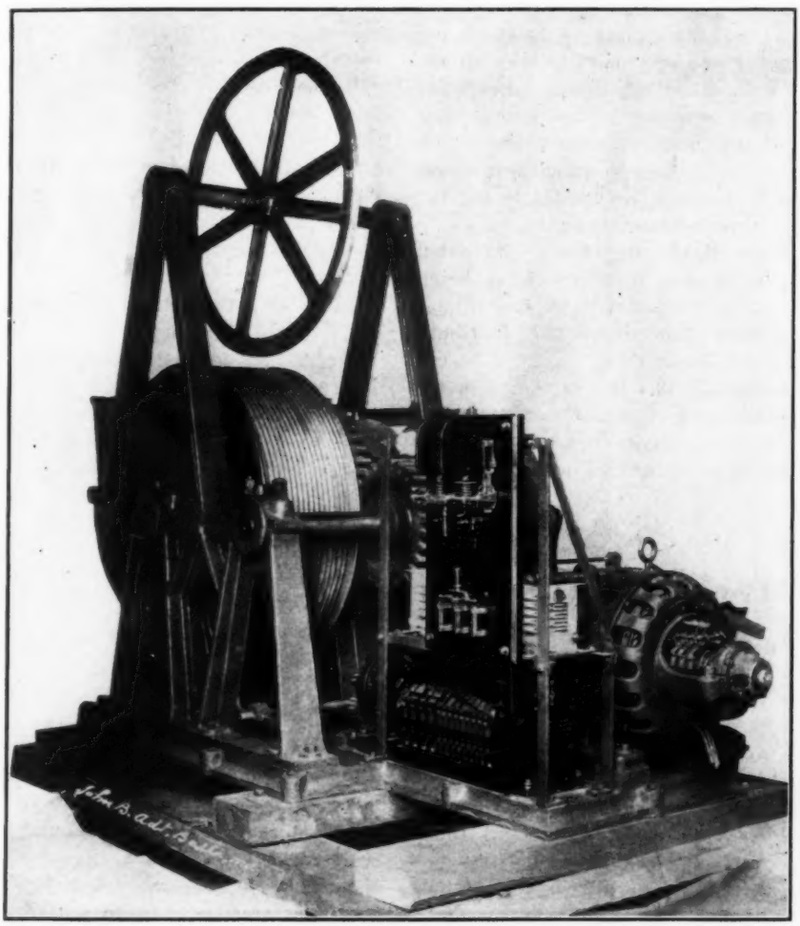
BRISTOL-DURAND AVERAGING INSTRUMENT FOR CIRCULAR CHART RECORDS.

As the length of the arcs of concentric circles for given angles or for the entire circumference are proportional to their radii, it is evident that the amount of turning of the integrating wheel, and the reading obtained thereon, will be proportional to the average radius of the record traced.

The instrument is adapted for integrating charts with either straight or curved radial time arcs. The correction necessary for radial time arcs which are curved may be made, after completely tracing the record, by returning the tracing point to a point on the chart having the same radius as the starting point.

A Good Electric Freight-Elevator Installation.

The accompanying illustration shows very clearly the simplicity and compactness of the power equipment necessary to operate an electric elevator. The cable drum, the controller, and the motor can all be so placed together as to occupy very little space, and the entire plant requires practically no attention. Two of these freight elevators were recently installed at the Charleston Navy Yard by John B. Adt, Baltimore, Md. Each machine has a capacity of 5,000 pounds, and weighs 12,000 pounds net.



MOTOR-DRIVEN FREIGHT-ELEVATOR EQUIPMENT.

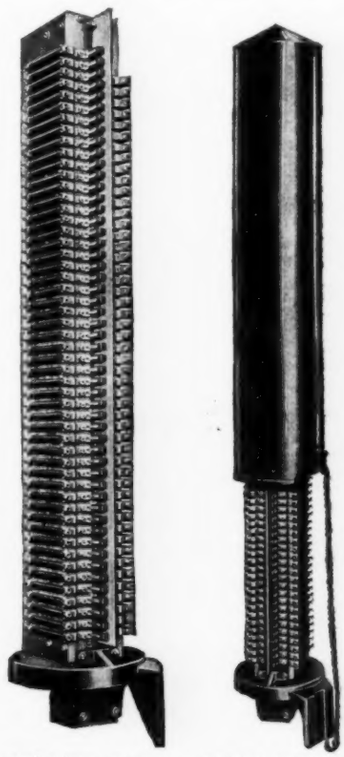
The hoisting machine is of the tandem worm-gear construction. The bronze worm wheels engage each other and right and left worms placed tandem on one shaft in a double housing. As the thrust is absorbed in the right and left worms, thrust bearings are not necessary. The worms are submerged in oil. Heavy spur gears transmit the power to the winding drum. An effective brake, quick-acting, with two parallel-moving, leather-lined shoes is attached to the worm shaft. Automatic terminal stop appliances, as well as a slack-cable device, are attached to the front of the worm-gear housing, where they are all readily accessible for adjustment.

A Westinghouse type HF fifteen-horsepower reversing induction motor, designed to operate on a three-phase 220-volt sixty-cycle circuit, is direct-connected to the worm shaft and runs at 860 revolutions per minute. This type of induction motor is especially suited for applications where a strong starting effect is needed, and where induction motors of the squirrel-cage type would take so much starting current as to seriously disturb the line voltage, and if the circuit on which the motor operates, carries a lighting load, it is, of course, imperative that there be a close voltage regulation. The motor is started by throwing the full line voltage upon the primary; the speed is then increased by reducing the resistance in series with the secondary. The starting, reversing and acceleration are accomplished through the Westinghouse automatic controller shown in the illustration.

The hoist frame, the motor, and the controller are all bolted to a substantial, one-piece bed-plate. The entire equipment it is said requires only an occasional inspection, cleaning and oiling .

New Protected Cable Terminal.

The Western Electric Company announces that it has placed on the market a new type of cable terminal which combines all of the advantageous features of several of the older types. The new terminal is a compact, weather-proof device, designed for mounting on the pole and which affords protection to the central office equipment against lightning discharges and accidental contact with power wires.



PROTECTED CABLE TERMINAL WITH COVER REMOVED.

CABLE TERMINAL WITH COVER PARTLY REMOVED.

The No. 18 protected cable terminal consists essentially of a rectangular oiled and shellaced wooden box into which the cable is led. Two sides of this box serve as mountings for the fuse clips and as fanning strips for the bridle wires. The third side acts as a

support for cut-outs. During manufacture the interior of the box is filled with water-proof pot head compound, which fills all spaces between the fanned-out wires and seals the end of the cable against moisture. The box is mounted on a cast iron base, or bracket, in the center of which is fitted a wooden bushing for clamping the cable in place and relieving the wires of all strain.

The cable chamber, binding posts and connections are protected against weather by a heavy reinforced, galvanized sheet-iron hood which may be lifted to any height necessary to examine the fuses, etc. The hood is held at the desired height by a spring latch mounted on top of the fanning strips. However, should the hood be removed completely it will be prevented from falling to the gorund by a non-corrosive sash-chain which attaches it securely to the bracket.

The protective devices supplied consist of fuses and open-space, carbon-block cut-outs, two of each wired into each pair of wires, the cut-outs being connected between the fuses and the cable.

The Western Electric Company manufacture this type of protected terminal for use with No. 22 gauge wire, paper insulated lead covered cable in capacities of from ten to sixty pairs of wires.

Ordinarily the terminal is supplied with a six foot cable stub which is spliced to a cable of sufficient length to make the connection desired. However, where possible, the terminal should be ordered with a cable of the required length, thereby eliminating one splice.

Boulevard Lighting for Rockford, Ill.

A motion was made at a recent meeting of the city council of Rockford, Ill., to install a system of boulevard lighting to take the place of the present arc lighting system. It is proposed to place the lamps on iron poles about eighty feet apart, an arrangement which would necessitate installing over 200 poles.

The cost of installation, which would amount to about two dollars per lineal foot, would be borne by the property owners. After the first year the expenses of operation would be borne by the city, payment being made from the yearly lighting appropriation of the council.

Waage Electric Soldering Iron.

The advantages of electric heating devices are well illustrated in the Waage electric soldering tool shown in the accompanying illustration. The operation of ordinary soldering irons is expensive and inconvenient, as it involves the continuous use of gas and sometimes compressed air, and the expense and trouble are also increased by delays due to continual reheating, waste heat and frequent necessary renewals. With gas it is impossible to keep the iron at the correct temperature continuously; moreover fumes from escaping gas are a frequent occurrence and a menace, as they induce fire risk. It is exceedingly difficult to maintain a proper soldering-heat outdoors and there are many places which are so confined or so difficult of access that it is almost impossible to use the gas or torch-heated tools.

These disadvantages are eliminated in the Waage iron, which is being placed on the market by the Illinois Appliance Company, 165 Dearborn Street, Chicago, Ill.

A view of this tool is shown in the accompanying illustration. Its chief claim to popularity lies in its adaptability to instantaneous use and the uniform heat that is maintained. Low current consumption is also assured by the manufacturers who state that in thirty-five days the cost of the tool will be saved.

SECTION OF WAAGE ELECTRIC SOLDERING IRON.

The advantage of forty per cent less maintenance expense is also a feature made possible by employing direct heating methods, combined with a new heating element which is said to have a resistance equal to mercury and a fusing point of 2,800 degrees Fahrenheit.

An advantage of the electric soldering tool, over other types, lies in the fact that no time is lost in changing irons, also no poor joints are obtained on account of the iron being too cold for use.

The Waage electric soldering tool is constructed on scientific principles with no unnecessary parts to make it complete. The heat is developed wholly within the forged copper working tip, which is constructed of extra heavy and durable material. This tip, it is said, will stand considerable filing and may easily be replaced at a reasonable cost. The heating element is also easily replaced and is manufactured to give from 800 to 1,500 hours of actual service. An idea of the simplicity of construction of this tool may be gained from the view of the cross-section shown herewith.

This tool is made in six sizes ranging in current consumption from forty to 140 watts. Six feet of cord is furnished with each tool.

The manufacturers' agents will be pleased to make comparative tests with special tools, such as can-topping, branding-irons, etc. The same approved characteristics of design and construction that are embodied in the Waage soldering-iron are also true of the soldering pots, glue pots, sealing-wax heaters, etc., handled by the Illinois Appliance Company.

Results of a Consistant Advertising Campaign.

By way of stimulating the demand for a useful accessory in the use of household electrical appliances the Benjamin Electric Manufacturing Company, of Chicago, Ill., has been conducting a unique advertising campaign on its No. 92 plug cluster. The device in question is well known to the electrical trade but is of such general utility that the manufacturers thought it would prove profitable to bring it more directly to the attention of the user. In order to do this a series of popular descriptive advertisements were run in the *Saturday Evening Post*, together with regular advertisement copy in the various standard electrical journals. These advertisements were supplemented with attractive circular matter for the dealer.

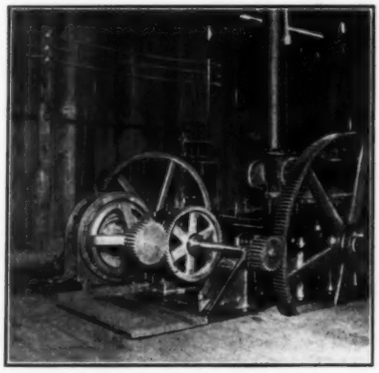
Apart from the added general publicity which this co-operative campaign has furnished the company, a net increase in sales averaging about fifty-one per cent is said to have been brought about. It cannot be said that any one factor is responsible for these results. Each has contributed a part. The success of the campaign is the sum total of these parts.

Application of Rawhide Pinions.

Rawhide pinions are usually considered merely as a means of stopping noise on medium and high speed drives and by far the largest percentage of them are used for that purpose. It is a matter of engineering experience, however, that rawhide is beneficial on gear drives where there is vibration from irregular load, etc.

This is well illustrated in the instance of the 1,750-gallon quintuplex pump in the power plant of the Parral Power and Reduction Company, Parral, Chihuahua, Mexico. This pump, as shown in the illustration, is geared through double reduction to an induction motor and furnishes the circulating water for the condenser.

Originally this pump was driven entirely by cut steel pinions and cast iron gears. The pump was of so light a pattern that there was considerable spring in both shaft and frame. The result was constant annoyance from broken gear teeth and in addition to gear renewals, there was quite an expense due to the power loss of running the engines non-condensing while pump repairs were being made.



APPLICATION OF RAWHIDE PINIONS TO PUMP MECHANISM.

To overcome these objections four "New Process" pinions made by the New Process Raw Hide Company, Syracuse, N. Y., were substituted for the four steel pinions. Two of these are shown in the photograph, one on motor and the other meshing with the big gear at the left. The other two are on the other side of the motor and placed symmetrically to those shown. These rawhide pinions were put into service over two years ago and reports state that there has been no trouble with the gearing since. In fact, the pump has been out of service only long enough to repack the plungers and replace the rubber valves.

"Saca" Attachment for Tungsten Lamps.

Within the last few years the tungsten lamp has forged rapidly to the front and is now replacing the carbon lamp in almost every case, due to its great efficiency, and its inherent self-regulating ability. However, whatever may be the final development of the metallic filament lamp, it is, without doubt, true that at the present time the filaments will not stand rough handling, and severe jars or shocks will break the filament.

The greatest problem seems to be in mills and factories where the lamp is suspended by a vertical cord from the ceiling, and where this ceiling acts as a floor which is subjected to jars from machinery, or caused by dropping heavy masses of material. The obvious way of relieving these sudden jars is by means of a shock absorber which will translate the sudden jar into an easy spring.

SACA ATTACHMENT FOR TUNGSTEN LAMPS.

For mill work a shock absorber should be simple, cheap, extremely resilient, and capable of being attached to standard construction without removing the cord. The shock absorber illustrated herewith possesses all of these features, and the further feature of also acting as a cord adjuster, hence its name "Shock Absorber, Cord Adjuster."

It will be noticed that it consists of a piece of flexible, non-rusting wire, coiled into a spiral with extended arms, one end of each arm being formed into a U-shaped loop. The arms are crossed so that the spring is under compression and not under tension, and the U-shaped loop in the end permits the adjustment of the cord.

This device is sold by the Condit Electric Manufacturing Company, of Boston, Mass., and is handled by all large supply dealers.

Miniature Enclosed Arc Lamps.

The American Arc Lamp Company, Kalamazoo, Mich., manufacturers of multiple, direct-current enclosed arc lamps, is manufacturing and placing on the market a miniature lamp, shown in the accompanying illustration, which embodies the same commendable features of construction as those which characterize the standard lamps.

These miniature lamps, which are suitable for either interior or exterior lighting, are equipped with the "north-all" swinging covers which permit of instant access to the interior. The covers, which are interchangeable, are made of pressed sheet brass. For outdoor service the lamps are provided with copper tops, and with pressed steel tops for indoor service.

AMERICAN MINIATURE ENCLOSED ARC LAMP.

The resistance is wound in such a manner that any unit may be instantly removed or replaced. The switch is of the rotary design and is said to be positive and reliable in action. The magnet coil is composed of two solenoids, asbestos wound and very durable. The clutch is enclosed in a glass case in plain view.

The American miniature lamp is rated at 500 candlepower, is nineteen and one-half inches long and weighs twelve pounds, complete with glassware. The carbons are three-eighths inches by eleven inches in size.

An Old-Time Electric Light Man.

Edward J. O'Beirne is one of the pioneers in the electric lighting industry of this country. At the recent convention of the National Electric Light Association, which celebrated its twenty-fifth anniversary at St. Louis in May, Mr. O'Beirne was one of three of those present who formed the group which attended the first meeting of the National Electric Light Association in Chicago in 1885. The other two were Elmer A. Sperry and Chas. W. Price.

Mr. O'Beirne commenced manufacturing electric light towers at Elgin, Ill., during 1880, and later organized the Star Iron Tower Company, at Fort Wayne, Ind. During 1887 he was superintendent of the Louisiana Electric Light and Power Company, at New Orleans, and built what was then considered the largest arc-light plant in existence, having a capacity of 2,100 arc

EDWARD J. O'BEIRNE.

lamps and lighting the entire city of New Orleans.

Later he was for eight years connected with the Fort Wayne and General Electric Companies, but since 1895 has followed the business of a contracting engineer. During the past fifteen years he has constructed more than thirty central-station plants. In 1896 he was elected president of the Gainesville (Texas) Electric Company; in 1897, vice-president of the San Antonio (Texas) Electric Company; in 1906, vice-president of the Hattiesburg (Miss.) Traction Company; in 1907, president of the General Contracting Company, of New Orleans; in 1908, president of the Washita Electric Power Company, Paul's Valley, Okla. He spent most of 1909 in Europe on a well-earned vacation, and early in the present year established the firm of Edward J. O'Beirne & Company, at Elgin, Ill., manufacturing lighting specialties.

In the early years of the power business, Mr. O'Beirne was associated with John S. Bowen, of Elgin, Ill., who called to order the first convention of the National Electric Light Association. During 1885, Mr. O'Beirne, then located at Fort Wayne, published the first annual issue of the American Electrical Directory, containing 300 pages, and in 1886 the second edition, consisting of 500 pages. These books are rare now, but contain much that is historical in the electrical field. Mr. O'Beirne has always been a strong advocate of lighting cities with electric towers, and with the improvements recently made in arc lamps he insists that the towers now give a better light and cover a wider area than in the old way.

Wireless Directors Meet.

The directors of the United Wireless Telegraph Company recently held a protracted meeting after which it was announced by counsel that a report on the company's finances had been called for and would be considered at another special meeting to be held on July 12.

President C. C. Wilson called the meeting to order. He told the assembled directors that the object of the meeting was to "have an investigation of the affairs of the company made by such directors of the company as were not officers."

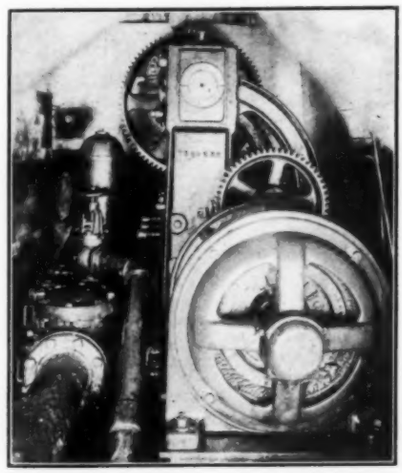
It was finally decided to have these directors act as an investigating committee, but to call on the officers for a detailed financial statement.

Remarkable Performance of Induction Motor.

The performance of apparatus under exceptional circumstances reveals the weak or strong points in its design, and its suitability for the service for which it has been installed. Due to the fact that reliable manufacturers design their apparatus with a large factor of safety, remarkable records are sometimes made.

A twenty-horsepower, three-phase, 220-volt standard induction motor made by the General Electric Company recently demonstrated the ability of the standard motors manufactured by this company to operate successfully under the trying conditions met with in mines where the air is very damp, without their being totally inclosed. This is of great importance, as thorough ventilation of the motor is absolutely necessary due to the high temperatures which prevail in mines. This motor is geared to a mine pump, located at the bottom of the shaft at the mines of the Richmond Iron Works, Richmond Furnace, Mass., and is installed in a chamber where the air is always very damp and moisture is continually dripping from the roof timbers. It is protected from this water by a piece of tarred paper tacked above it, so as to conduct the water away.

During a heavy thaw last January, the surface water broke in on one of the upper levels and flooded the mine. The water rose so rapidly that the electric



INDUCTION MOTOR DRIVING MINE PUMP.

pump was soon under water, the top of the motor being two feet below the surface. Under such circumstances it was imperative that the pump should continue in operation as long as possible, and so it was not shut down. It continued to operate perfectly and at the end of two hours, during the whole of which time the motor was submerged under water, it had pumped itself clear of water. It was then stopped only long enough to clean the dirt and chips from around the rotor, and put oil in the bearings, and then was started up again. This pump has been running about twenty hours a day ever since and the motor has apparently suffered no injury from its unusual experience.

Imports of copper for the month of May were 14,000 tons, against 11,500 tons the same period last year.

Current Electrical News

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, JUNE 24.—Electric traction is to be applied on the section of the Mont Cenis railroad line lying between Bardonnechia and Modane, and it is expected to have this part of the line ready for traffic early next year. A type of 2,000-horsepower locomotive has already been designed for the purpose, and it will be constructed by the Brown-Boveri firm. Such locomotives will be operated at 7,000 volts, three-phase. At the first-mentioned locality there will be installed a substation in order to furnish the 7,000-volt current, and it will take its supply from a 48,000-volt power line coming from a turbine plant in the region.

The Heroult process for the manufacture of steel by the electric furnace is to be used by the Metallurgical Company, of Hainault, which is at present operating a large works. A special plant will be installed for the steel production, and it is intended to turn out high-grade steel especially. A number of electric furnaces are to be erected.

In the Dauphine region of France there is a power line in operation which is supplying current to the industrial center of St. Etienne at 3,000 volts. For this purpose the hydraulic plants of Olle and Riozonne have been erected and they are working in parallel with a steam plant which is located at St. Victor. I also note that the turbine plant of Lannemezan in the Pyrenees region has made an increase in its machines lately. A new project in the Jura district is concerned with erecting a hydraulic plant on the Bieene river in the neighborhood of Morez in order to furnish current for a number of consumers. A company is already formed for the purpose.

There is a project of considerable importance on foot in Switzerland for erecting several hydraulic plants, and it is being promoted by the combined Kander and Hagneck Company of Berlin, which is operating these two turbine plants at present. The proposed hydraulic work is to be carried out upon the Aar stream and several lakes such as the Engstel, Gelmer and others. There will be five separate turbine plants in all, according to the present ideas, and the largest of these will be located on the lower Aar and is expected to furnish 80,000 horsepower. A second plant on the upper Aar will have an output of 40,000 horsepower. The different lakes will serve as natural basins so as to have a large reserve supply. In all, it is estimated that 140,000 horsepower can be produced, and the total amount of the project is 32,000,000 marks.

A. DE C.

LIGHTING AND POWER.

(Special Correspondence.)

LEWISTON, IDA.—The Lewiston-Clark Improvement Company has engineers at work at Grande Ronde, preliminary to installing a power station. A.

KARNES CITY, TEXAS.—R. L. Spillar, of Manor, Texas, is considering the proposition of erecting an electric light and power plant at this place. D.

GRANITE FALLS, MINN.—A vote will be taken July 12 on issuing bonds for $40,000 for improving the electric light and water works plant and the water power. C.

SPUR, TEXAS.—An electric lighting plant is to be erected at Spur by J. E. Johnson, of Stamford, Texas. It is planned to have the plant in operation by August. D.

FORAKER, OKLA.—The town of Foraker has voted to issue $30,000 of bonds to build and operate a water and light plant. Work will begin on the plant as soon as the contracts are let. D.

MISSION, TEXAS.—The Minneapolis Steel Company, of Minneapolis, Minn., has made a proposition to erect an ice and electric light plant here. The proposed plant will cost about $13,000.

PORTLAND, ORE.—A $100,000 power company has been incorporated by J. C. Donnelly, H. J. Mabby and others. The company intends to develop electric power for hauling trains over the mountains. A.

ASHLAND, ORE.—Ashland voted $55,000 improvement bonds at a special election recently. Of this, $25,000 is to complete the municipal electric light plant and $30,000 will go for paving street intersections.

SHOALS, IND.—The town board has granted a franchise to James F. Lynch and associates for the installation and operation of an electric light and power plant. Work on the same is to be begun at once. S.

WILMINGTON, DEL.—The Kent Water, Light and Power Company has been incorporated with a capital of $25,000, with the following incorporators: H. T. Downing, W. N. Hass, H. T. Shelley, Philadelphia, Pa.

BERKELEY, CAL.—Tuesday, July 19, has been set by the city council as the day on which the Great Western Power Company's franchise for operating its plant and for the sale of electric current, will be disposed of. A.

MARICOPA, CAL.—N. C. Shippee, president and general manager of the West Side Electric Company, announces that the plant is to be enlarged to furnish power and light in the adjacent oil fields, Taft and Moran. A.

INDIANAPOLIS. IND.—The Board of Review has increased the return of $421,430 by the Indianapolis Light and Heat Company to $500,000. There was no increase over the return of the Merchants' Heat and Light Company. S.

AUBURN, N. Y.—A new decorative lighting system has been installed in the principal streets of this city. The lamp posts used are twelve feet in hight and each carries a cluster of five lamps. The posts are placed 100 feet apart.

GADSDEN, ALA.—The city has granted a franchise to R. H. Cobb, Gadsden, promoter of the Coosa River Power Company, to furnish light and electricity. The plant must be ready and in operation not less than five years from date. B.

DURHAM, N. C.—The board of aldermen have granted to the Southern Power Company a sixty-five-year franchise. It is stated that the company's lines would probably reach here in about eight months. One of the sub-stations will be located here.

NEWARK, N. J.—The Public Service Electric Company has been incorporated to manufacture and distribute electric power. The capital of the company is $15,000,000 and the incorporators are: T. N. McCarter, Rumson; E. H. Hine, Orange; D. Farrand, Newark.

SAN ANDREAS, CAL.—The Sierra Nevada Water Company will soon be reorganized under another name. The new company is being formed to complete one of the largest water and electric plants in the State. Frank Z. Towle is expected to continue as manager. A.

TOMBSTONE, ARIZ.—H. D. Madison and Mate Brown have leased the plants of the Tombstone Improvement Company and the Tombstone Electric Light and Power Company. This gives the lessees control of the gas, water and electric light utilities of Tombstone. D.

BIRMINGHAM, ALA.—Caldwell & Watson will build a new foundry, to be electrically operated throughout; electric cranes, etc., replacing the present plant equipment. The new plant will be steel and re-enforced concrete, practically fireproof, to cost about $25,000. B.

GALVESTON, TEX.—The improvements on the city electric-light plant, including the installation of two turbo-generators, new street lamps and other apparatus have been completed and are now in operation. The work done represents an expenditure of between $24,000 and $25,000.

EVANSVILLE, IND.—The board of directors of the Evansville Gas and Electric Light Company has elected officers as follows: President, H. D. Walbridge, of New York; vice-president, B. C. Cobb, of New York; secretary, F. J. Haas, of Evansville, and treasurer, A. C. Blinn, Evansville. S.

BISMARCK, N. D.—The Hughes Electric Company is erecting a modern fireproof plant. An 800-horsepower cross-compound engine and mechanical stokers will be installed and the capacity of the plant increased fifty per cent. It is expected to have the new plant ready for occupancy by October 1. C.

NEW YORK, N. Y.—The City Island Light and Power Company of New York has been incorporated with a capital stock of $20,000. The concern will provide electricity for light, heat and power. The directors are B. L. Burroughs and James M. Gorman, of New York, and Fred J. Phillips, of Brooklyn.

BALDWINSVILLE, N. Y.—Baldwinsville is now lighted with an all-arc light system of electric lights. Under the new contract made last year with the Seneca River Power Company, which is for five years, sixty-six arc lamps at $73 per lamp per year are furnished, making the cost of the village lighting now $4,818 per year.

KLAMATH FALLS, ORE.—A power plant is to be located on Warner Creek, or as it is locally known, Deep Creek, twenty-two miles east of Lakeview, Lake county, Oregon, by a party of capital-

ists from Spokane. It is estimated that over 7,000 horsepower will be developed and that the owners can dispose of all the power that can be secured.

INDIANOLA, IOWA.—J. H. Clark, city clerk, will receive bids up to 7 p. m., July 11, for a 16 by 36 inch Corliss engine, delivered and erected, including foundation, and a 150-kilowatt direct-current engine-type generator. A check for ten per cent of the bid must be sent. C.

RAPID CITY, S. D.—The Dakota Power Company has let the contract to the Allis-Chalmers Company for the balance of the machinery required to fully equip its plant, amounting to several thousand dollars. The new equipment will consist largely of transformers. C.

READING, MASS.—At a special town meeting it was voted to extend the electric light service to North Reading and $12,000 was appropriated for the purpose. Oother appropriations were: For extension of lighting system in town $1,200, and for improvement of street lights $200.

ROCK HILL, S. C.—The board of public works of this city recently bought a lot and closed a contract with an engineer, Mr. Rucker, of Charlotte, for plans and specifications for a municipal light plant, and work was started at once. Rock Hill is at present getting lights from a local company known as the Rock Hill Water and Electric Company.

SAN FRANCISCO, CAL.—The Richmond Light and Power Company has been incorporated by S. F. T. Brock, J. S. Lamson, A. L. Chickering, W. Dorn and E. Williams, with a capital stock of $2,500,000. The object of the new corporation is to take over the old Richmond Light and Power Company and enlarge it to meet the demands of the surrounding country.

VANCOUVER, B. C.—The Vancouver Power Company, a subsidiary organization of the British Columbia Electric Railway Company, is planning to develop 100,000 horsepower of electric energy. The source of power is located in Chilliwack Lake and Jones Lake, both lying in the Chilliwack district. $10,000,000 will be expended in developing the two sources. A.

DANVILLE, IND.—The Danville Light, Heat and Power Company, which is now supplying current to three of the largest towns in Hendricks County and the farmers along the lines, is preparing to extend the lines to Coatsville, Clayton and Mooresville, and will likewise furnish current to the farmers along the new lines to be installed in order to reach the additional towns.

TAYLORVILLE, ILL.—This city has voted to expend $61,500 on lighting contracts, improvements and general maintenance of the city's departments. In the course of its meeting, the council laid on the table the contract submitted by the Taylorville Gas and Electric Light Company to light the city. The tenure of the contract was not less than two years, nor more than five years.

MONTGOMERY, ALA.—Richard Tillis, of Montgomery, has bought ninety-five per cent of the capital stock of the Citizens Light and Power Company at stated price of $135,000. Mr. Tillis says that the company will make improvements, including substantial enlargement of the present plant, the company's wires be extended all over the city and improvements made immediately. B.

TALLADEGA, ALA.—The Alabama Power and Development Company has begun remodeling its building in which will be installed substation and offices here. Work on the company's transmission lines to Anniston and Jackson Shoals is reported as proceeding rapidly. It is also reported this company will make a survey for a proposed trolley line from Talladega to Gadsden via Anniston. B.

REDDING, CAL.—The Inskip power plant of the Northern California Power Company was recently started up, adding 8,000 horsepower to the output of the company and making its total 27,000 horsepower, itemized as follows: Volta powerhouse, 9,000; Kilarc, 4,000; South powerhouse, 6,000; Inskip, 8,000. Inskip is on the South Battle Creek, in Tehama County, one mile from the Shasta line. A.

LANSING, MICH.—W. A. Foote, of Jackson, who is organizing the big water power merger, recently went before the state railway commission with an application for the issue of $500,000 in bonds by the Grand Rapids-Muskegon Power Company, to take up outstanding issues of bonds. It is stated in the application that the present indebtedness of the concern is $600,000 and authority for further issues will be asked later.

MARBLE FALLS, TEXAS.—The construction of the large dam across the Colorado River and installation of a hydroelectric plant at this place by C. H. Alexander of Dallas and associates has been delayed by the scarcity of labor. Mr. Alexander says that he hopes to have the work finished by September 10. In addition to supplying power and lights for Marble Falls transmission lines will be built to a number of towns in this section. Machinery is also being installed here for a large cotton mill by Mr. Alexander and associates. D.

CULIACAN, MEXICO.—It is announced that the Mayo River Power and Land Company of Denver, Col., which has a capital stock of $5,000,000, will install two or more hydroelectric plants in the state of Sinaloa for the purpose of providing power for operating portions of the Southern Pacific Railroad of Mexico. The company will also furnish power for a number of towns and industrial plants in this region. It will install other hydroelectric plants in the states of Chihuahua and Sonora. The sites for these proposed plants have been selected. D.

SALT LAKE CITY, UTAH.—The Davis County Light and Power Company plant and equipment have been purchased by the Home Telephone and Electric Company for $50,000 and from now on the telephone and electric light systems will be operated together. The power plant of the company is in Farmington canyon and is 1000-horsepower. The telephone system extends through Davis County and into Weber County. Recently the telephone company increased its capitalization from $40,000 to $250,000 to make the purchase of the power plant possible.

RICHMOND, VA.—The common council has voted the sum of $20,000 for the more brilliant illumination of Broad Street, in conformity with a report from the finance committee of the council. The matter has been sent on to the board of aldermen for their action thereon. Plans outlined provide for the placing of six large tungsten lights on each block, three on each side of the block, along the street named from Jefferson Street to Twelfth Street. The city is interested in the better illumination of its streets and the appropriation named is regarded as certain of passage. L.

RICHMOND, VA.—The New River Power Company has been incorporated to construct waterpower electrical plants on New River, in four or more separate developments. About 45,000 horsepower will be generated, with transmission lines and substations for delivering electricity to cites, towns and mines in Southwest Virginia, between Roanoke and Bristol, and to Bluefield, W. Va., and Mount Airy, N. C. The approximate cost of the complete plant will be $6,000,000. Officers elected are: President, F. S. Viele, 49 Wall Street, New York; vice-president, Hugo Kohlmann; secretary, W. M. Blain, both of New York; treasurer, Percy H. Goodwin, of H. C. Brown & Co., Calvert Building, Baltimore, Md.

SALEM, MASS.—The Salem Electric Light Company proposes to spend more than $200,000 in improving its property in Salem. It expects to spend about $75,000 in improving its plant on Peabody Street. It has recently purchased the Clark wharf property on the South river, adjoining its own wharf. It has plans for building an addition to its plant and for putting in new apparatus for generating electricity. It also expects to spend more than $100,000 in improving its equipment for the distribution of electricity. It will spend $100,000 in building a conduit system. The Legislature, upon request of the city of Salem, has ordered the company to put its wires under ground within the crowded portions of the city.

ST. LOUIS, MO.—Negotiations have virtually been completed for the consolidation of the King Electric Company and the Suburban Electric Light and Power Company, which heretofore have been operated as separate companies in St. Louis County, but which have been owned by the same persons. The King company will retire from business, and the operations will be continued by the Suburban company. For six years the King company has been supplying the county with electric current. For each ten shares of Suburban stock thirteen shares of consolidated stock will be exchanged. Seventy-nine shares of consolidated will be given for each ten shares of King Electric. One of the most valuable assets of the King company is a blanket franchise obtained two years ago from the County Court.

CHARLOTTE, N. C.—The Southern Power Company has completed negotiations for taking over the entire plant of the Greenville Carolina Power Company, according to advices received here, and thus adds a valuable hydroelectric development to its numerous plants of a similar nature in the Carolinas. The Greenville plant generates 6,000 horsepower, and is situated on the Saluda River, about four miles west of the town. The company now has in operation the Catawba station, twenty miles southwest of Charlotte, the Ninety-Nine Islands plant, the Rocky Creek and the Great Falls plants, which with the Saluda River plant, gives a total output of nearly 105,000 horsepower. The amount involved in the deal for the Greenville Carolina plant is not stated but is believed to be close to half a million, as real estate, transmisison lines, and other properties are included. L.

GRAND FORKS, N. D.—H. M. Byllesby & Company, of Chicago, have purchased the property of the Grand Forks Gas and Electric Company, which operates in this city and in East Grand Forks, Minnesota. The electric property at Red Lake Falls, Minnesota and certain other smaller properties were acquired also. All were formerly owned by Minneapolis interests headed by W. J. Murphy, publisher of the Minneapolis Tribune. A new company which will operate the properties acquired in and near Grand Forks has been organized. It is called the Red River Power Company. This. Roycraft has been retained as local manager. The Red River Power Company proposes at once to make extensive additions and improvements to the gas and electric systems at Grand Forks and East Grand Forks, including the extension of many miles of distributing mains and lines into sections not now served.

ELECTRIC RAILWAYS.

(Special Correspondence.)

SEBASTOPOL, CAL.—John E. Bennett has been granted a franchise for an electric line from the power house in Sebastopol to the town limits. A.

MARTINEZ, CAL.—A. W. Maltby, vice-president of the Antioch Electric Railroad, has applied for a franchise to operate trains on the county roads between Martinez and Pacheco. A.

PATERSON, N. J.—The trolley road to Hohokus has been opened and is now in operation. A number of men prominent in this district were on the cars that made the opening trip.

SAN FRANCISCO, CAL.—The city has filed for record the release of the Stockton Street Railway franchise, recently executed by Frank J. Stringham and his associates in the contemplated railway line. A,

SAN FRANCISCO, CAL.—The San Francisco and Transbay Railroad Company has been incorporated by H. H. McCloskey, E. Schnutenhaus, J. Comerford, A. Mulverhill and T. Block, with a capital stock of $1,500,000. A.

LOS ANGELES, CAL.—The Mutual Home Building Corporation which recently purchosed 200 acres in the northeast corner of the original city of Los Angeles, will soon build an electric railway to the top of the Montecito Hills. A.

FORT WORTH, TEXAS.—The Northern Texas Traction Company and the Citizens' Electric Railway Company has made an agreement to use the same tracks for a distance of two miles on North Main Street, North Fort Worth. D.

SAPUPLA, OKLA.—It is stated that the Oklahoma Union Traction Company will begin work immediately on the interurban line which it is to build between Sapupla and Tulsa. The electric line will traverse the Glenn Pool oil fields. D.

NEW HAVEN, CONN.—The Connecticut Company has taken out a municipal permit for the erection of trolley barns at the corner of Grant and Blatchley avenues. The structure will be of brick and steel, and the estimated cost is $20,000.

SAN FRANCISCO, CAL.—The Oakland & Antioch Railway Company has filed a deed of trust with the Anglo-California Trust Company, covering all the property of the corporation to secure an issue of $2,000,000 worth of thirty-year five-per cent bonds.

SOUTH BEND, IND.—It is officially announced that arrangements have been made between the Chicago, Lakeshore and South Bend Electric Railway and the Illinois Central Railway, whereby the former road will run its electric trains into Chicago and land its passengers at the down town station.

MIDDLETOWN, CAL.—The Santa Rosa and Clear Lake Railroad will be in operation by the first of November of this year. The line is to be an electric road and will run from Santa Rosa, via Burke's Sanitarium, Mark West Springs, Kellogg, Quicksilver and Middletown to the waters of Clear Lake at Lower Lake. A.

PACIFIC GROVE, CAL.—The first spike was recently driven in the Monterey and Del Monte Heights Railway at the Del Monte Heights terminus. The road when completed will be three miles long, connecting with the present electric line at Del Monte, and extending through Seaside to Del Monte Heights.

FT. WAYNE, IND.—With the provision that the Ft. Wayne & Winona traction line, projected by J. A. Barry and associates, be completed from Ft. Wayne to Warsaw by 1912, the Commissioners of Allen county granted the company the right-of-way through the county. A bond for $2,000 was filed to carry out the contract. S.

LOS ANGELES, CAL.—The Los Angeles Pacific Railway Company has decided to spend $10,000,000 in the erection of a depot and in building a subway through populous parts of the city in order to establish a direct line to Venice and Santa Monica. R. C. Gillis, president of the Company, states that construction work will begin in August. A.

INDIANAPOLIS, IND.—A judicial sale of the Indianapolis & Cincinnati traction line will be ordered because all the stockholders have refused to agree to the plan of reorganization. The plan was to reorganize with a capital of $1,000,000 and complete the proposed extension from Connersville to Hamilton, Ohio. C. L. Henry is receiver for the road. S.

DAVENPORT, IOWA.—Announcement is made that the German Trust Company, of Davenport, has taken $1,000,000 first mortgage bonds of the Muscatine North & South Railway Company, which were issued for the purpose of making an extension of the Muscatine road from Elrick Junction to Burlington. C.

LIMA, OHIO.—The new $75,000 interurban station in process of erection here by the Schoepf syndicate is fast nearing completion, and when finished will be one of the finest in this section. General offices including dispatchers will be located on the second floor. It is said negotiations are under way which will result in the Western Ohio running into the station. H.

LANSING, MICH.—Contracts have been awarded for the construction of an electric road between this city and Grand Ledge. The line is all to be on a private right of way, with third-rail motive power. J. S. Mudge and J. W. Ewing, of Grand Ledge, promoted the road, and R. E. Olds, of this city, is said to be interested with them in the company. The road is to be in operation next winter.

CRIPPLE CREEK, COLO.—Incorporation papers were filed for the Colorado Springs and Cripple Creek Aerial Tramway Company. The company is capitalized for $500,000 and its purpose is to provide for the transportation of ore, coal and other commodities between Colorado Springs and Cripple Creek. The tramway will be seventeen miles long. The directors are: H. McCarry, Peter H. Holmes, L. L. Aitken, Orville L. Dines and E. W. Giddings.

OAKLAND, CAL.—Following the severe criticism cast upon the Oakland Traction Company by the State Railroad Commission owing to the car-wreck on the California railroad on Memorial Day,—the traction company is laying a double track line and installing sidings along the right of way leading to Leona Heights. The work is being done in conformity with the Interstate Commerce Commission rules, under which the California Railroad is operated. A.

AKRON, OHIO.—It is reported that the Northern Ohio Traction Company is to locate its new $2,000,000 power plant in this city. The plant will probably be built within a year. For some months the Northern Ohio Traction Company officials have been making plans for the erection of a big central power house. The increased traffic, it is stated, has made this necessary. The company now has power houses at Bedford, Cuyahoga Falls, Akron, Canton, Midvale and New Philadelphia.

GARY, IND.—At the regular annual meeting of the Gary & Interurban Railway, held at the Gary offices, a refunding and first mortgage bond issue of $10,000,000 to refund the present bonds of $500,000 and to provide for further development in the Calumet district was authorized. Practically all of the stock of the company was represented at the meeting. The following directors were elected: Frank N. Gavit, A. C. Miller, J. D. Price, C. W. Chase, F. H. Wood. The two last named are new members of the board, taking the places of F. C. Raff, of South Bend, and George Ross, of Chicago, vice-president of the Chicago & Alton Railway.

ROSWELL, N. M.—A party, consisting of W. R. McDowell, of the Berrendo Irrigated Farms Company, George W. York, head of the bond department of Otis & Hough, financial agents of Cleveland, Ohio, and Warren Bicknell of Havana, president of the Havana Street Railway Company, owning all the street railways in Cuba, have visited Roswell with the view of building an electric interurban running north to the Berrendo farms and south to several small towns in the lower Pecos valley. The Roswell Electric Light Company is now owned and operated by Otis & Houth of Cleveland. The proposed line would pass through a rich territory. D.

SOUTH BEND, IND.—As a result of a conference held in South Bend by M. H. Lane, president of the Chicago and Kalamazoo Terminal Railroad; Fred H. Bennett, president of the Chicago, Kalamazoo and Eastern; Edward G. Folsom, Logansport, formerly manager of the Fort Wayne and Wabash Valley line; M. P. Reed and Ray W. Reynolds, superintendents of the Southern Michigan and Southern Indiana Railway companies, of this city, an interurban line will be built from South Bend to Kalamazoo, Mich., within a short time. With the completion of the line, it will be possible to go from Detroit to Louisville by trolley. The new line will be via Sister Lakes, Dowagiac, Decatur, Pawpaw and Mattewan. The Chicago, South Bend and Lake Shore is also figuring on making an extension from South Bend to Elkhart, Kalamazoo and Toledo.

HOUSTON, TEXAS.—The Galveston & Houston Interurban Railway Company, which is constructing an interurban electric line between Houston and Galveston, fifty-one miles, has decided to locate its central power plant at Webster, twenty-two miles south of Houston. It will erect three substations, one about eight miles south of Houston, another near Dickinson, and the third between Texas City and Virginia Point. The power house at Webster will be between Texas City and Virginia Point. The power house at Webster will be 70 by 100 feet in size and will be two stories high. It will be of steel frame, with brick and concrete walls and foundation. The equipment will consist of three 520-horsepower Babcock & Wilcox boilers, or an aggregate horsepower of 1,560; one 11,000-kilowatt turbine, one 500-kilowatt turbine, and all the necessary condensers, water heaters, feed pumps, air compressors and other accessories. Power will be generated at 2,300 volts and will be stepped up to 3,300 volts for transmission to the substations. At the substations the power will be stepped down to 2,300 volts, alternating current, and will be delivered to motor-generators furnishing 600 volts direct current to the trolley. The substations will be built of steel frames and of brick construction. It is expected that the road will be finished by the time the causeway across Galveston bay, which will give it an entrance to Galveston, is completed. D.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

JONESBORO, ARK.—The Home Telephone Company will expend $30,000 in improvements. P.

CUBA, MO.—The Cuba Telephone Company has been incorporated with a capital stock of $8,000. P.

GREENFIELD, MO.—The Mutual Telephone Company has been incorporated with a capital stock of $20,000. P.

SUGARTOWN, LA.—W. B. Wellborn and others are organizing a company to construct rural telephone lines. P.

HALSEY, ORE.—The Halsey Mutual Telephone Company has been organized to furnish telephone service in this city.

GAINESVILLE, GA.—The New Bridge Telephone Company has been incorporated here by D. C. Whelchel and others.

EL PASO, TEX.—The Tri-State Telephone Company will build toll lines east to Dallas, Tex., and west to California points. P.

GARFIELD, WASH.—The Garfield Town and Rural Telephone Company has been incorporated by W. B. Harris, J. A. Dix, F. M. Scott and others.

MINNEAPOLIS, MINN.—The Tri-State Telephone and Telegraph Company has decided on extensive additions to its plants in the Twin Cities and throughout the state. C.

KERKHOVEN, MINN.—The Kerkhoven-Louriston Telephone Company has been incorporated with a capital of $5,000 by Wm. and Otto Strom and Fred Armstrong and others, of Murdock, Minn. C.

OLYMPIA, WASH.—The Consolidated Printing Telephone Company has been incorporated by G. Mackay, C. E. Collier, B. A. Barr, F. B. Rae, J. H. Kugler, G. F. Parker, and J. D. Bancus, with a capital stock of $25,000,000.

NEWBURYPORT, MASS.—The New England Telephone and Telegraph Company recently changed its quarters from the Chase & Lunt building to a building erected for the purpose. A common-battery system is now in use.

INDIANAPOLIS, IND.—The Indianapolis Telephone Company has applied to the free employment bureau for two hundred laborers. The company is preparing to enter upon the work of modernizing and extending its plant. S.

HUDSON, COLO.—The telephone exchange in this place was opened recently and direct connection has been established with Denver. The town of Hudson, which is but a few months old, is a direct result of the work of reclamation of a large tract of land.

MINNEAPOLIS, MINN.—Improvements on its local and toll lines, calling for an expenditure of $1,000,000, will be made by the Northwestern Telephone Exchange Company within the next year. This was decided upon at the annual meeting of the board of directors in Minneapolis. New members on the board of directors are Edward A. Prendergast and G. E. McFarland. The officers were all re-elected and the usual dividend declared.

COLUMBUS, OHIO.—Officials of the Columbus Citizens' Telephone Company recently went to New York to confer with the firm of J. P. Morgan & Company relative to improvements to be made in the Ohio telephone properties of the Morgan firm during this year. The Morgan properties in Ohio include the Columbus, Citizens, the Toledo Home, the Dayton Home, the Cuyahoga and the United States Telephone companies, with the eleven subsidiary companies of the latter company.

ELECTRICAL SECURITIES.

The decided drop in the value of the greater part of the stocks during the past week was ascribed by many to the fact that big blocks of certain stocks were suddenly thrown on the market. Reports of droughts and the decisions of interstate commissions on freight rates also had a decided effect. These factors would undoubtedly account for a moderate decline, but the slump in the general list is out of all proportion to what their influence should have been had not the organized bear party been there to give quotations other hard pushes down hill.

The annual meeting of stockholders of the Westinghouse Electric and Manufacturing Company will be held July 27.

The Massachusetts Railroad Commission has approved the petition of New Haven road for acquisition of 19,288 shares, being not less than half of the stock of the Berkshire Street Railway Company.

The New York Public Service Commission, Second District, has authorized the Hornell & Bath Interurban Railway Company to issue $195,000 bonds, proceeds to be used in the construction of the company's line from Hornell to Bath, Steuben County. Previous authorization allowed the company to issue $450,000 bonds and the amount now allowed is in addition.

The Scranton Railway collateral trust fives, dues 1932, have been called in for exchange at the Provident Life and Trust Company, Philadelphia, for Carbondale Railway Company general mortgage fives, due 1933. The July 1 coupon will not be paid on the Scranton Railway Company collateral trust fives, but will be paid on Carbondale Railway Company general fives if and when exchange is made.

The New York Up-State Public Service Commission has authorized the Bath Electric and Gas Light Company to execute a first mortgage upon all its property, to secure $250,000 in thirty-year five per cent bonds, and to issue at present $150,000 of these bonds, $44,500 of the bonds to be sold at not less than 80, for improvements to plant. The balance of the bonds authorized at this time are to be used to refund $100,000 of the outstanding bonds, and discharge $31,990 bills payable.

It is now known that the Philadelphia Rapid Transit Company will show a loss in gross receipts for the year ending June 30 of less than $300,000. This is a more favorable result than has been anticipated. A few weeks ago the estimate was $400,000, while during the strike predictions of much heavier losses were freely made. June earnings made an excellent comparison with the year, despite the rains in the early part of the month, and even when allowance is made for the fact that during the first three days of last June a strike was in progress. In the fair weather of the latter part of the month gains were very marked.

DIVIDENDS.

American Gas and Electric Company; quarterly dividend of one per cent on the common stock, payable July 12 to stock of record July 5.

Bell Telephone of Philadelphia; quarterly dividend of one per cent, payable July 15.

Boston Suburban Electric; preferred quarterly dividend of $1 per share, payable July 15.

Colorado Telephone Company; semi-annual dividend of three per cent, payable July 15.

Fort Smith Light and Traction; preferred quarterly dividend of one and one-quarter per cent, payable July 15.

Oklahoma Gas and Electric; preferred quarterly dividend of one ane three-quarters per cent, payable July 15.

Ottumwa Railway and Light Company; preferred quarterly dividend of one ond three-quarters per cent, payable July 15.

Public Securities; initial preferred dividend of seven per cent, payable July 1.

San Diego Consolidated Gas and Electric; preferred quarterly dividend of one and three-quarters per cent, payable July 15.

United States Light and Heating; preferred semi-annual dividend of three and one-half per cent, payable July 15.

NEW YORK.

	July 4	June 27.
Allis-Chalmers common	8½	8⅝
Allis-Chalmers preferred	27	31
Amalgamated Copper	60⅝	64⅛
American Tel. & Cable	*80	*80
American Tel. & Tel.	132¼	136
Brooklyn Rapid Transit	74⅛	78½
General Electric	140	144
Interborough-Metropolitan common	17¾	18¾
Interborough-Metropolitan preferred	51	52
Kings County Electric	124	124
Mackay Companies (Postal Telegraph and Cables) common	85½	88
Mackay Companies (Postal Telegraph and Cables) preferred	73	73
Manhattan Elevated	125	126
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
U. S. Steel common	72	77⅝
U. S. Steel preferred	115	116¼
Western Union	61	64¼
Westinghouse common	60	63
Westinghouse preferred	125	125

*Last price quoted.

BOSTON.

	July 4	June 27.
American Tel. & Tel.	132¼	136
Edison Elec. Illuminating	250	248
General Electric	140	144
Massachusetts Electric common	14¾	16
Massachusetts Electric preferred	75	80
New England Telephone	133	132
Western Tel. & Tel. common	15	15
Western Tel. & Tel. preferred	84	84

PHILADELPHIA.

	July 4	June 27.
American Railways	43	44
Electric Company of America	11½	11⅝
Electric Storage Battery common	48½	55
Electric Storage Battery preferred	48½	55
Philadelphia Electric	14⅝	14⅞
Philadelphia Rapid Transit	18½	19⅜
Philadelphia Traction	84½	74¼
Union Traction	44½	47

CHICAGO.

	July 4	June 27.
Chicago Railways, Series 1	70	70
Chicago Railways, Series 2	16¼	19
Chicago Subway	2	2¼
Chicago Telephone	116½	120
Commonwealth Edison	112½	114
Metropolitan Elevated common	22	24
Metropolitan Elevated preferred	69½	69½
National Carbon common	116	116½
National Carbon preferred	118	118

PERSONAL MENTION.

PAUL M. MOWREY, who was engaged in the electrical business in New York City, died recently after an illness of several months. Mr. Mowrey leaves a widow and four children.

J. CHARLES RUNYON has been appointed designing engineer of the Post-Glover Electric Company of Cincinnati, Ohio. Mr. Runyon has for some time been engaged in the design of electrical machinery and apparatus.

PROF. HATSUNE NAKANO, who holds the chair of electrical engineering in the College of Engineering of the University of Tokyo, is at present visiting this country. He received degrees from Cornell University in 1888 and 1889.

W. S. DOREMUS, of Erie, Pa., has taken charge of the sales agency recently established by the General Electric Company in that city. The office was established for the convenience of the company's patrons in northwestern Pennsylvania.

WILLIAM F. DAWSON has returned from England and will cooperate with H. F. T. Erben, of the General Electric Company in direct-current design work. Mr. Dawson has been engaged in this work in England for the past five years, during which time he was connected with the British Thomson-Houston Company, Ltd.

SILAS E. WEIR has accepted a position with the Triumph Electric Company of Cincinnati, as shop superintendent. Mr. Weir, who was formerly connected with The Western Electric Company of Chicago, has had a long and varied experience in the manufacture of direct and alternating-current machinery, and is peculiarly fitted to assume the responsibilities of the position he now holds.

J. C. LAWLER, who has for some years been connected with the Colorado Springs Electric Company as electrical engineer, has resigned to become superintendent of the operating department of the Richmond Gas and Electric Company at Richmond, Ind. Both companies are controlled by the Susquehanna Light, Power and Railway Company of New York, and Mr. Lawler's new position is in the nature of a promotion.

CAPTAIN W. B. ROCKWELL, formerly general manager of the Syracuse and Suburban Railway, has been appointed general manager of the Eastern Pennsylvania Light, Heat and Power Company, the Eastern Pennsylvania Railways Company, the Pittsville Union Traction Company, and the Tumbling Rock Park Association. The companies control seven railroads, the superintendents of which are responsible to Captain Rockwell.

J. P. CLARK, an electrical engineer, from the State of Michigan, has been elected vice-president and general manager of the Piedmont Traction Company, which has been termed the "North Carolina end" of the proposed 250-mile interurban electric railway system which the Southern Power Company has under consideration, and for which provision has been made in South Carolina for lines connecting Anderson, Greenville and Spartanburg. The Piedmont Traction Company, of which Mr. Clark is made general manager, is at present engaged in working out plans for an interurban line connecting Piedmont, North Carolina, mill towns, including Mt. Holly, eleven miles west of Charlotte, and probably Gastonia, and other points.

J. R. RICHARDSON, who recently became manager of the Chicago office of the Pacific Electric Heating Company, has experienced rapid promotion since he became connected with that office about two years ago as general utility man. He obtained his technical training while a student at Armour Institute of Technology, but secured much practical experience while working for various electrical companies during his summer vacations. When leaving college, however, he was content to start at the bottom and became the shipping clerk, receiving clerk and general office boy of the Pacific Electric Heating Company. In October, 1908, a factory was opened in Chicago for the repair of electric flatirons and their assembling after shipment from the main works. Mr. Richardson was placed in charge of this factory which has steadily grown in importance. Recently he was placed in charge of the Chicago sales office of the company as well and has just completed the reorganization of both this department and the Chicago factory to meet the rapidly growing demands of the company's business in the Chicago territory.

PROPOSALS.

POST OFFICE, LITCHFIELD, ILL.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until August 3, for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the United States Post Office at Litchfield, Ills., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Litchfield, Ills., or at the Supervising Architect's office.

POST OFFICE, DECORAH, IA.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until August 10, for the construction, complete, (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the United States Post Office at Decorah, Iowa, in accordance with the drawings and specification, copies of which may be obtained from the custodian of site at Decorah, Ia., or at the Supervising Architect's office.

POSTOFFICE, AMSTERDAM, N. Y.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until August 8, for the construction, complete, (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the United States Post Office at Amsterdam, N. Y., in accordance with the drawings and specification, copies of which may be obtained from the custodian of site at Amsterdam, N. Y., or the Supervising Architect's office.

NEW PUBLICATIONS.

THE ADVANCE BIO-BULLETIN.—In the June 13 publication of this name is contained a paper on "Graphite," read by Dr. Edward G. Acheson before the Automobile Club of America, in New York City and before the National Gas and Gasoline Engine Trades Association, Cincinnati, Ohio. A number of very interesting points regarding Mr. Acheson's investigations and discoveres are mentoned and much information given as to the properties of "Oildag." One of the features of this number is a sketch of the life of Doctor Acheson.

TESTS OF TIMBER BEAMS.—This publication, by Arthur N. Talbot, issued as Bulletin No. 41 of the Engineering Experiment Station of the University of Illinois, is a detailed report of the tests of a large number of full-size timber bridge stringers. The test beams included new, seasoned, and creosoted wood of several species. The report also gives the result of shear and bending tests on specimens cut from the large beams. Important conclusions concerning strength and other properties of structural timber are given.

REPORT OF COAST AND GEODETIC SURVEY. The Coast and Geodetic Survey has recently published the results of magnetic observations made at the Honolulu observatory in 1905 and 1906. Hourly readings of the declination, the horizontal and the vertical intensity of the earth's field, are given, with a summary of monthly means. A record of earthquakes and magnetic storms is also included. Copies of this publication may be had upon application to the Superintendent of the Coast and Geodetic Survey, Washington, D. C.

THE TELEPHONE REVIEW.—The June number of this publication, which is designed for circulation among the employes of the New York Telephone Company, contains an interesting account of the evolution of the telephone systems of the New York City police department. A series of illustrations is used to show the various steps in the development of the system. This, the first number of the monthly magazines, gives promise of an interesting publication. The magazine has no subscription price and carries no paid advertising, being for educational purposes only.

ENGINEERING DATA ON THE SANITARY DISTRICT OF CHICAGO.—A pamphlet bearing this title has been issued by the Sanitary District of Chicago, under date of June, 1910, and contains brief engineering data on all of the engineering ventures of the District. The data on the main channel, power house, transmission lines, north shore channel, pumping stations and subchannels is compiled in a convenient manner bringing out all of the essential points. In addition there is a map of the territory covered by the District and detailed information as to how to reach all points mentioned.

NEW INCORPORATIONS.

LAUREL, DEL.—The Delaware Electrical Safety Company has been incorporated to deal in electric goods of all kinds. The capital stock is $10,000.

PORTLAND, ME.—The Wirt Electric Specialty Company has been incorporated with a capital of $50,000 to manufacture and deal in electrical and other apparatus and machinery. T. L. Crotean of Portland is president, and Albert T. Jones treasurer.

CHICAGO, ILL.—The Eclipse Electrical Manufacturing Company has been incorporated with a capital of $15,000 to do electrical work and to manufacture and deal in electrical appliances. The incorporators are: William E. Bodenstab, John Renner and Frederick Kirchhoff.

INDUSTRIAL ITEMS.

THE McROY CLAY WORKS, Chicago, Ill., has issued its July calendar and blotter, advertising McRoy conduits.

THE ELECTRICAL ALLOY COMPANY, Morristown, N. J., has issued as leaflets, price lists of its copper, brass and eighteen per cent German silver ribbon.

THE NEW YORK & OHIO COMPANY, Warren, Ohio, gives in its June price list of Packard lamps, the prices on its small low-voltage lamps and bases. Directions on ordering automobile lamps are also sent for the benefit of the general buyer.

THE S. K. ELLIOT ELECTRIC COMPANY, Cleveland, O., announces that it has since July 1, discontinued the sale of Westinghouse generators, motors, etc., and will hereafter deal only in apparatus manufactured by the Fort Wayne Electric Works of Fort Wayne, Ind.

THE HOLOPHANE COMPANY, of Newark, Ohio, has recently opened an office in Philadelphia, Pa., in the Stephen Girard Building, No. 21 South Twelfth Street, Room No. 1222. With the office in this location the company will be at the disposal of the architects, fixture houses and jobbers of the city.

THE STONE & WEBSTER ENGINEERING CORPORATION, Boston, Mass., presents in booklet form a complete list of "Work Done and Work Doing." The booklet, which covers the second quarter of 1910, is very well compiled and gives an excellent idea of the wide scope of the operations of this company.

THE C. W. HUNT COMPANY, New York, N. Y., builders of coal-handling, conveying and hoisting machinery, has opened offices at State Bank Building, Richmond, Va., and also at 607 Rhodes Building, Atlanta, Ga., with W. F. Lee, for several years preliminary engineer to the company, in supervision.

THE J. LANG ELECTRIC COMPANY, Chicago, Ill., has published tables of carrying capacity of copper wire and of wire size for direct current motors, in connection with a diagram of a McWilliams "Meterite" Panel board. The whole is printed on a chart which may be hung on the wall and is so arranged that any data desired may be found in a moment.

THE MOORE LIGHT COMPANY, Newark, N. J., has been incorporated to handle the manufacture and sale of the Moore Light under license from the Moore Electrical Company. The Moore Electrical Company will continue as a holding company and own the Moore Light patents. The general offices and factory of the Moore Light Company will continue at 169 Malvern Street, Newark, New Jersey.

THE GUARANTEE ELECTRIC COMPANY, Chicago, Ill., announces that it is now located in a new building at the corner of Clinton and Van Buren streets and has a larger and more complete line of second-hand motors, generators, etc., than even. The new building is thoroughly equipped with modern machinery, and is of such size as to meet with the requirements of the business for some years to come.

THE PETTINGELL-ANDREWS COMPANY, Boston, Mass., publishes as a feature article in its July number of *Juice*, a conversation between a salesman and a prospective buyer. Other special articles are "Economy in Construction Material," "Universal Switch Boxes." There are also some trade tips to central stations on "Exemplar" irons, an article on Manson tape for automobile and motor-boat trade, and some information on the Schafer guy clamp.

THE AMERICAN ELECTRIC FUSE COMPANY, Muskegon, Mich., has published booklet No. 350 on enameled magnet wire, treating both of the special properties of the product and of some of its uses. The publication has two objects; first, to set forth in easily understood terms the advantage to be gained from using enamel-insulated instead of fabric-insulated wire, and second, to call attention to the facilities and equipment which the company has for manufacturing the wire. The booklet is well illustrated and contains a number of diagrams, pictures of windings and views taken in various parts of the shops.

THE WESTERN ELECTRIC COMPANY has just issued its bulletin No. 1110-1 describing telephones and signaling apparatus for mines. It contains two double-page lay-outs, one a mine plan, the other a wiring diagram for signaling sets and telephones. The bulletin is profusely illustrated with photographs. It contains cuts of the No. 343-A emergency set for mine use, the No. 1336 type metal mine telephone set and the No. 341 emergency signal bell, together with desk and wall type magneto telephones, and a description of the availability of each of these instruments for varying uses in mines. The ground plan shows the location of the apparatus for a combined telephone system and emergency signaling system in a mine. This plan has been made expressly to comply with the law relating to telephones and gongs in the state of Illinois, and it covers a complete protective system for mines. It is followed by a wiring diagram of a combined system of mine telephones and emergency signaling bells.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has distributed to the trade Bulletin 1070, entitled "Barometric Condensers, Type B." This condenser is said to be the most simple and efficient apparatus of this type which has thus far been developed. The condenser head is built entirely of cast iron, and the interior construction includes no bolts, screws, rivets, or any parts that can get out of place, and nothing that requires adjustment or attention. Each nozzle is cast on a different section of the condenser so that it may be turned in any direction to suit local conditions. The overflow pipe comes in service only on full loads and overloads, and also prevents, at all times, flooding the condenser, regardless of the quantity of water which may be pumped into it. The water and air separator, to prevent water going over into the dry-air pump, is generally placed on top of the condenser head, but in some cases, where the head room is limited, it is placed beside the condenser and connected with the top of same with piping, the drain from the separator being run either into the overflow pipe or hot well, to best suit local conditions. The air is taken from the side near the top of the water and air separator, to the dry-air pump. Copies of this bulletin may be had on application to the company.

DATES AHEAD.

National Electric Contractors' Association. Annual convention, Altantic City, N. J., July 20, 21 and 22.

Ohio Electric Light Association. Annual convention, Cedar Point, Ohio, July 26, 27 and 28.

Michigan Electrical Association. Annual convention, Port Huron, Mich., August 16, 17 and 18.

League of American Municipalities. Annual convention, St. Paul, Minn., August 23-26.

Pacific Coast Electrical Exposition. San Francisco, Cal., August 20 to August 27, 1910.

New England Section, National Electric Light Association, Fall convention, Pleasant Point, New London, Conn., September 13 and 14.

Colorado Electric Light, Power and Railway Association, Next convention, Glenwood Springs, Col., September 21, 22 and 23.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 10-14.

Directory of Electrical and Allied Engineering and Scientific Societies

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ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary, Lloyd Lyon, secretary and auditor Mobile Light and Railway Company, 158 Government Street, Mobile, Ala.

AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, 29 West Thirty-ninth Street, New York, N. Y.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Smithsonian Institution, Washington, D. C.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Dr. J. W. Richards, Bethlehem, Pa.

AMERICAN ELECTROTHERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, 352 Willis Avenue, New York City.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary, Dr. Richard Moldenke, Wachtung, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West Thirty-ninth Stret, New York city.

AMERICAN INSTITUTE OF MINING ENGINEERS. Secretary, Rossiter W. Raymond, 29 West Thirty-ninth Street, New York city.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West One Hundred and Sixteenth Street, New York city.

AMERICAN PHYSICAL SOCIETY. Secretary, Prof. Ernest Merritt, Cornell University, Ithaca, N. Y.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN-RAY SOCIETY. Secretary, Dr. G. C. Johnson, 514 Bijou Building, Pittsburg, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 29 West Thirty-ninth Street, New York city.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West Forty-seventh Street, New York city.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, A. P. Folwell, Flatiron Building, New York city.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, H. C. Donecker, Engineering Societies Building, 29 West Thirty-ninth Street, New York city.

AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, H. E. Weeks, secretary and treasurer Tri-City Railway Company, Davenport, Iowa.

AMERICAN STREET AND INTERURBAN RAILWAY CLAIM AGENTS' ASSOCIATION. Secretary, B. B. Davis, claim agent Columbus Railway and Light Company, Columbus, Ohio.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, J. W. Corning, electrical engineer Boston Elevated Railway Company, Boston, Mass.

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CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

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CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Acton Burrows, 157 Bay Street, Toronto, Canada.

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CENTRAL ELECTRIC TRAFFIC ASSOCIATION. Secretary, J. T. Brittson, assistant claim agent Chicago, South Bend & Northern Indiana Railway Company, South Bend, Ind.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. C. Lawler, Colorado Springs, Colo.

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ELECTRICAL CLUB OF CALIFORNIA. Secretary, Russell D. Holabird, Argonaut Hotel, San Francisco, Cal.

ELECTRICAL CONTRACTORS' ASSOCIATION OF INDIANA. Secretary, George Skillman, Indianapolis, Ind.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, George William Russell, Jr., 25 West Forty-second Street, New York city.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Ernest S. Cowle, 1613 Crand Avenue, Kansas City, Mo.

ELECTRICAL CREDIT ASSOCIATION OF CANADA, LIMITED. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Canada.

ELECTRICAL CREDIT ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, 1343 Marquette Building, Chicago, Ill.

ELECTRICAL CREDIT ASSOCIATION OF PHILADELPHIA. Secretary, John W. Crum, 1324 Land Title Building, Philadelphia, Pa.

ELECTRICAL CREDIT ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, San Francisco, Cal.

ELECTRICAL CREDIT SOCIETY OF NEW YORK. Secretary, Franz Neilson, 80 Wall Street, New York city.

ELECTRIC CLUB OF CHICAGO. Secretary, F. S. Hickok, Marquette Building, Chicago, Ill.

ELECTRIC VEHICLE AND CENTRAL STATION ASSOCIATION. Secretary, H. T. Sands, 139 Pleasant Street, Malden, Mass.

EMPIRE STATE GAS AND ELECTRIC ASOCIATION. Secretary, Charles H. B. Chapin, 29 West Thirty-ninth Street, New York city.

ENGINEERS' CLUB OF PHILADELPHIA. Secretary, H. G. Perring, 1317 Spruce Street, Philadelphia, Pa.

ENGINEERS' SOCIETY OF MILWAUKEE. Secretary, W. Fay Martin, Milwaukee, Wis.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA. Secretary, Elmer K. Hiles, 2511 Oliver Building, Pittsburg, Pa.

FLORIDA ELECTRIC LIGHT AND POWER ASSOCIATION. Secretary, H. C. Adams, West Palm Beach, Fla.

FRANKLIN INSTITUTE. Secretary, Dr. R. B. Owens, 15 South Seventh Street, Philadelphia, Pa.

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ILLUMINATING ENGINEERING SOCIETY. Secretary, Preston S. Millar, Engineering Societies Building, 33 West Thirty-ninth Street, New York city.

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INDIANA ELECTRIC LIGHT ASSOCIATION. President and acting secretary, C. C. Perry, Indianapolis Light and Heat Company.

INDIANA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Walter J. Uhl, Logansport, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y.

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MAINE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, M. E. Crow, Houlton, Me.

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MISSOURI ELECTRIC, GAS, STREET RAILWAY AND WATER WORKS ASSOCIATION. Secretary, N. J. Cunningham, Springfield, Mo.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, George W. Schwerer, Windsor, Mo.

MUNICIPAL LIGHTING ASSOCIATION OF MASSACHUSETTS. Secretary, J. C. Norcross, Reading, Mass.

NATIONAL ACADEMY OF SCIENCES. Secretary, Arnold Hague, United States Geological Survey, Washington, D. C.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, N. H. Morton, 41 Martin Building, Utica, N. Y.

NATIONAL ELECTRIC CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago, Ill.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny Street, Hartford, Conn.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, T. C. Martin, 33 West Thirty-ninth Street, New York city.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. B. Ware, Monadnock Block, Chicago, Ill.

NEBRASKA ASSOCIATION OF INDEPENDENT TELEPHONE COMPANIES. Secretary, Charles H. Hood, Lincoln, Neb.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary Alton F. Tupper, 84 State Street, Boston, Mass.

NEW ENGLAND SECTION, NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, L. D. Gibbs, 39 Boylston Street, Boston, Mass.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl Street, Boston, Mass.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, En-

gineering Societies Building, 29 West Thirty-ninth Street, New York city.
NEW YORK RAILROAD CLUB. Secretary, H. D. Vote, 95 Liberty Street, New York, N. Y.
NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.
NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.
OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.
OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.
OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio.
OKLAHOMA ELECTRIC LIGHT, RAILWAY AND GAS ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.
OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION. Secretary, Frank J. Sherrer, 195 Broadway, New York city.
ORDER OF THE REJUVENATED SONS OF JOVE. Mercury, Roy M. Van Vliet, Monadnock Block, Chicago, Ill.
PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, Van Dusen Rickert, Pottsville, Pa.
PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.
PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.
PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo.
PITTSBURG ELECTRIC BOOSTERS' CLUB. Recording Wattmeter, O. R. Rombach, 919 Liberty Avenue, Pittsburg, Pa.
RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa.
SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.
SOCIETY OF AUTOMOBILE ENGINEERS. Secretary, Alexander Churchward, 30 Church Street, New York city.
SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. D. Forbes, 96 Franklin Street, South Framingham, Mass.
SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. R. Buck, Hudson, S. D.
SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, W. B. Head, Stephensville, Tex.
STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, C. Gordon Reel, Kingston, N. Y.
TELEPHONE SOCIETY OF NEW YORK. Secretary, T. H. Lawrence, Eighteenth Street and Irving Place, New York city.
TEXAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, T. A. Gould, Ennis, Tex.
UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk Street, Boston, Mass.
VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. B. Seeley, St. Johnsbury, Vt.
VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester, Vt.
WASHINGTON SOCIETY OF ENGINEERS. John C. Hoyt, 1314 F Street, Washington, D. C.
WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 125 Monroe Street, Chicago, Ill.
WESTERN SOCIETY OF ENGINEERS. Secretary, J. H. Warder, Monadnock Block, Chicago, Ill.
WISCONSIN ELECTRICAL ASSOCIATION. Secretary, John S. Allen, Lake Geneva, Wis.
WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) June 28, 1910.

962,417. ELECTRICAL RECEIVING APPARATUS. James Murray Boyle, New York, N. Y. Filed July 28, 1905. A receiver comprising two physically different bodies of electrolyte has a minute region of connection and means for modifying this region.

962,431. TYPE-CARRIAGE-PROPELLING MECHANISM FOR PRINTING TELEGRAPH RECEIVERS. George S. Hiltz, Brooklyn, N. Y., assignor to The Stock Quotation Telegraph Company, New York, N. Y. Filed Nov. 16, 1908. Describes mechanism in detail.

962,435. INCANDESCENT LAMP SYSTEM. Yasuke Kawasaki, Vancouver, British Columbia, Canada. Filed July 28, 1908. Describes circuit connections for multifilament lamp.

962,436. ILLUMINATED SIGN. Edgar J. Kellner and William F. Edwards, New York, N. Y. Filed Feb. 4, 1910. The device uses a rectangular receptacle adapted to contain illuminating means, a cover for the receptacle consisting of a transparent plate and a rectangular frame L-shaped in cross-section adapted to support the plate, supporting means located within the receptacle and means adapted to co-operate therewith carried by the frame for retaining its edge portions in alinement with the edge portions of the receptacle.

962,455. SERVICE CUT-OUT AND METERING APPARATUS. Thomas E. Murray, New York, N. Y. Filed Dec. 21, 1909. A metering panel.

962,473. SWITCHBOARD CONSTRUCTION. William M. Scott, Philadelphia, Pa., assignor to The Cutter Electrical and Manufacturing Company. Original application filed March 1, 1905. Divided and this application filed Nov. 9, 1909. In combination with switchboard are busbars extending across the same, circuit leads, a plurality of automatic circuit-breakers mounted upon the switchboard and disposed one above another, the movable contact member of each circuit-breaker serving to connect a lead with a busbar, an upper terminal of a lower breaker disposed below an upper busbar, and the movable contact members of the breakers being mechanically interconnected.

962,492. RECORDING DEVICE. Geo. F. Card, Three Rivers, Mich. Filed Sept. 21, 1905. A clock-operated radially ruled record sheet is electromagnetically marked.

962,497. VAPOR-ELECTRIC APPARATUS. John T. H. Dempster, Schenectady, N. Y., assignor to General Electric Company. Filed April 4, 1904. A vapor-electric apparatus comprises a vaporized electrode, a fluid-retaining solid electrode, and means for conducting products of condensation from the vaporizable electrode to the fluid-retaining chamber of the solid electrode.

962,499. ELECTRIC HAMMER. Burton M. Dutton, Richmond, Va., assignor of one-half to William H. Oxenheim, Richmond, Va. Filed Feb. 16, 1909. Includes a solenoid and plunger, etc.

962,532. ELECTRIC FURNACE FOR METALLURGICAL PURPOSES. Heinrich F. D. Schwan, Belleville, Ill. Filed Mar. 24, 1909. An annular electric furnace, having an alternating electric-current transformer located in its center, is provided with plurality of electrodes, one number of the electrodes comprising each two parts, one of which is highly conductive for electricity while the other part is a resistance conductor being the electric terminal connecting by the highly conductive part with the transformer, while another number of the electrodes are normally good conductors for electricity and connecting with a direct-current generator.

962,533. TROLLEY-SWITCH. Frank L. Sessions, Columbus, Ohio, assignor to the Jeffrey Manufacturing Company, Columbus, Ohio. Filed May 5, 1908. A trolley crossing switch.

962,536. LIGHTNING-ARRESTING APPARATUS. Thomas M. Stevens, Watertown, Mass. Filed Jan. 3, 1910. A lightning arresting structure comprises a pair of spaced masts, a cable extending between the masts, a plurality of clamps secured at intervals upon the cable, a plurality of looped metallic tubes secured to the clamps, electrical conductors extending from the tubes, and ground-plates to which the conductors are connected.

962,552. FIRE-ALARM. Martin V. Crawford, Blaine, Wash. Filed Feb. 4, 1909. A thermo-responsive means for fire-alarm systems comprises a fixed terminal and an elastic terminal, and a strand of horse hair for holding the elastic terminal away from the fixed terminal against its elastic tendency.

962,589. RECEPTACLE OR SOCKET FOR ELECTRIC LAMPS. Walter S. Ryan, New York, N. Y., assignor of three-fourths to Louis Hengerer, New York, N. Y. Filed Aug. 21, 1909. An electric-lamp socket has diagonally disposed holes adapted to receive a holding device, and means to connect and disconnect the electric conductors therewith at will without severing the conductors.

962,604. SPARK-PLUG. George Walzel, New York, N. Y. Filed Sept. 3, 1909. A spark plug is provided with a cap, an inclosed charge of platinum sponge, an openwork keeper that confines the platinum sponge within the cap, a first electrode centered upon the keeper, and a second co-operating electrode.

962,645. TELEPHONE SYSTEM. Reason C. Livingston, Spring Valley, Minn. Filed May 21, 1908. A suitable main has its continuity broken at each station at two points; independently

operated switch each normally close a respective one of the breaks in the main; a telephone unit normally excluded from the main; a signal mechanism normally connected to the main through both switches and excluded from the respective side of the main by the operated switch; and means individual to each switch couple the telephone unit to the respective side of the main.

962,655. APPARATUS FOR ELECTROPLATING PIPES, ETC. Daniel Hayes Murphy, New Castle, Pa. Filed June 1, 1908. Includes provision for reciprocating the work.

962,683. DYNAMO-ELECTRIC MACHINE. Miles Walker, Manchester, England, assignor to Westinghouse Electric & Manufacturing Company. Filed June 5, 1905. A dynamo-electric machine comprises a rotatable member having a slotted core, bar, conductors and substantially uniform length located in the core slots and projecting beyond the ends of the same, connector rings having perforations to receive the projecting ends and insulated from each other and from the bars except at such points as will serve to connect the bars into a complete magnetizing winding.

962,687. SIGNALING DEVICE. Maurice J. Wohl, New York, and Harry Hertzberg, Brooklyn, N. Y., assignors to Abbot A. Low, Horseshoe, N. Y., Maurice J. Wohl, New York, N. Y., and Harry Hertzberg, Brooklyn, N. Y., trustees. Filed Mar. 16, 1908. A signaling device comprises a diaphragm, a thermal expansible conductor in the signaling circuit, and mechanical multiplying connection between the conductor and the diaphragm.

962,689. ELECTRICAL APPARATUS. Christian Aalborg, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed July 8, 1909. The tank or casing of a transformer has a base-plate provided with groups of teeth to register with foot flanges of the end plates of the magnetizable core member of the transformer.

962,692. ARC-LAMP. Thomas J. Anderson, Houston, Tex., assignor to the Anderson-Lacy Electric Headlight Company, Houston, Tex. Filed Nov. 30, 1908. A carbon holder is described.

962,694. PRINTING-TELEGRAPH RECEIVER. Marie Burry, New York, N. Y., executrix of John Burry, deceased, assignor to the Stock Quotation Telegraph Company, New York. Filed Aug. 27, 1908. The mechanism is described in detail.

962,709. TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa., assignor of one-half to William J. Latta, Philadelphia, Pa. Filed July 9, 1906. A telegraphic alphabet.

962,713. ELECTROPNEUMATICALLY OPERATED CONTROLLER. Joseph N. Mohoney, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed Sept. 3, 1907. In combination with a series of independently operated switches is an elastic fluid interlocking means therefor, and also electro-responsive means for initiating the action of the switches.

962,726. INSULATING-BUSHING. Chester H. Thordarson, Chicago, Ill. Filed Jan. 29, 1910. An insulating bushing for electric wiring comprises a headed insulating body, a split, screw-threaded sleeve adapted to be slipped endwise over the body and having means for locking it from rotation thereon and a flanged locking nut engaged over the sleeve and co-operating with means for locking the sleeve from endwise movement on the insulating body.

962,732. ELECTRIC-ARC LAMP. Heinrich Beck, Frankfort-on-the-Main, Germany, assignor to Beck Flaming Lamp Company, Canton, N. Y. Filed Nov. 15, 1906. Means for preserving a uniform distance between the arcing ends of a pair of electrodes and in their longitudinal movement, comprise members connected to the electrodes and movable therewith, and projecting therefrom toward each other the members having relative longitudinal movement, a roller carried by one of the members and engaging the other, for preventing lateral displacement thereof.

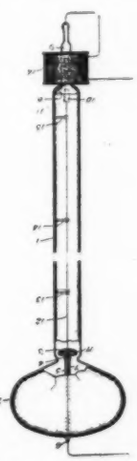
962,755. ELECTROPNEUMATIC TRACK-CHANNELER. Arthur Henry Gibson, Easton, Pa., assignor to Ingersoll-Range Company, New York. Filed Mar. 22, 1907. Comprises a movable truck, truck-driving means, a double-acting fluid-presser mounted on the truck, a plurality of tools adjustably mounted on the truck, tool pistons and flexible tubes connecting opposite sides of the different tool pistons with opposite sides of the presser piston and also opposite sides of the different tool pistons with each other whereby the tools are driven simultaneously in the same direction by the operation of the presser.

962,759. ELECTRIC MEASURING INSTRUMENT. Robert D. Hickok, Atlanta, Ga. Filed June 4, 1909. An electrical measuring instrument includes a current coil, a turning magnetic element located in the field of the coil for actuation thereby, the coil being pivotally mounted to enable a uniform angular relation between the coil and the element to be preserved under all conditions of current, and means connected to the element to yieldingly hold the same in zero position.

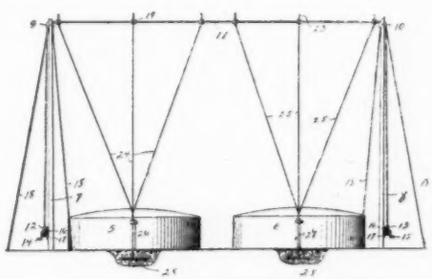
962,768. ELECTRIC SAD IRON. Henry G. Levy, San Francisco, Cal. Filed April 1, 1910. Has a removable handle, etc.

962,772. FLEXIBLE CONDUIT. George A. Lutz, Plainfield, N. J., assignor to American Circular Loom Company, Portland, Me. Filed June 6, 1908. A flexible tube comprises inner and outer strips bent into tubular form around their longitudinal axes and having corrugations, the joint of one strip being out of line with the joint of the other strip.

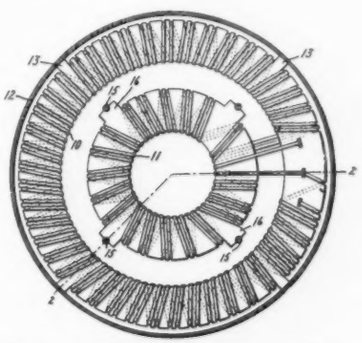
962,773. ELBOW FOR CONDUITS. George A. Lutz, Plainfield, N. J. Filed Aug. 3, 1908. An elbow for conduits is made in a piece of sheet metal bent into channel form having open-sided members at a right angle to each other, the open sides of the members facing each other of the members being permanently maintained at a right angle to each other.



692,497.—VAPOR ELECTRIC APPARATUS.



962,536.—LIGHTNING ARRESTER.



962,793.—ELECTRIC HEATING UNIT.

962,774. ELBOW FOR CONDUITS. George A. Lutz, Plainfield, N. J. Filed Aug. 13, 1908. An elbow for conduits has open side members at an angle to each other, the open sides of the members facing externally in different directions away from each other.

962,793. ELECTRIC HEATING UNIT. Herbert M. Smith, Pittsfield, Mass., assignor to General Electric Company. Filed March 29, 1909. An electric heater comprises a flat heating unit and a cup-shaped container therefor bent over the unit and having the metal reduced at the bend.

962,795. INCANDESCENT ELECTRIC LAMP. Alexander F. F. Stodd, Paterson, N. J. Filed June 23, 1909. An incandescent electric bulb lamp has a neck which is provided with a stem which extends into the bulb and with a plurality of annular enlargements through which feed and return circuit wires are passed, and which are also provided with radially and downwardly directed supports, and an incandescent filament is suspended from the supports and lies in a horizontal plane below the stem.

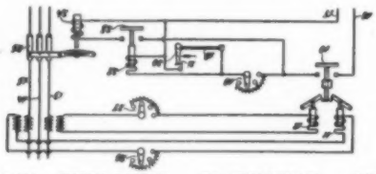
962,800. TELEPHONE SYSTEM. John B. Taylor, Schenectady, N. Y., assignor to General Electric Company. Filed May 3, 1909. A telephone system includes a transformer having two separate windings insulated from each other by a high-voltage insulation, receiving and transmitting apparatus connected to one of the transformer windings, a transmission circuit, a two-pole switch connecting the other transformer winding to and disconnecting it from the circuit, and a bell permanently connected across the circuit.

962,816. ELECTRICAL RECEPTACLE AND ROSETTE. Leger J. Castonguay, Bridgeport, Conn., assignor to The Bryant Electric Company, Bridgeport, Conn. Filed Dec. 17, 1908. An electrical appliance adapted for use at the flaring mouth of an electrical conduit, comprises an insulating body carrying terminals and having formed with the body a base flange by which it may be secured to the mouthpiece, the insulating flange having extensions with threaded thimbles, securing screws and a cover held in place by the latter.

962,817. TIME-LIMIT PROTECTIVE DEVICE FOR ELECTRIC CIRCUITS. Herbert W. Cheney, Norwood, Ohio., assignor to Allis-Chalmers Company and The Bullock Electric Manufacturing Company. Filed May 27, 1907. A protective device for electric circuits, includes a body of matter which varies in volume upon changes in temperature, an electric circuit for heating the body of matter and including the latter and arranged to be completed upon abnormal conditions in a circuit to be protected, a circuit-breaker in the last-named circuit arranged to be tripped when the value of the body of the matter reaches a predetermined value, and means for varying the rate at which the body of matter heats.

962,835. MOTOR CONTROL. Hugo Heymann, Berlin, Germany, assignor to General Electric Company. Filed Feb. 26, 1910. In combination with a separately excited generator supplying current to a motor, are means for varying the field strength of the generator, a field regulator for the motor and means for preventing the operation of the regulator until the motor reaches a predetermined speed.

962,856. STARTING DEVICE FOR ELECTRIC MOTORS. David H. Plank and Alfred C. Finney, Schenectady, N. Y., assignors to General Electric Company. Filed March 1, 1910. In combination with an alternating-current motor are: a supply circuit, a transformer, a plurality of electromagnetically operated switches for first connecting the motor to the supply circuit



962,877.—TIME-LIMIT PROTECTION DEVICE.

through the transformer and then connecting the motor directly to the supply circuit, and means whereby the motor can be connected directly to the supply circuit only within a predetermined interval after it has been connected and disconnected from the supply circuit through the transformer.

962,870. STORAGE BATTERY. Charles Frederick Washburn, New London, Conn. Filed Aug. 12, 1909. A plate made of a strip of lead is bent back upon itself so as to form bellows folds, and an aluminum plate bent back upon itself extends into the folds.

962,884. THERMO-ELECTRIC FURNACE-REGULATOR. James H. Bobbitt, Harvard, Nebr. Filed Oct. 7, 1908. The regulator comprises a furnace device, a motor mechanism connected therewith, a thermostatically-actuated switch, electrical means controlling the operation of the mechanism and connected in circuit by the switch, oppositely disposed and spaced electromagnets independently connected in circuit by the switch, a common index device actuated by the electromagnets for indicating the draft conditions of the furnace, an audible signal, and a make-and-break device operated by and connected with the motor mechanism for actuating the audible signal in a predetermined manner during the opening of the draft and in a different manner during the closing of the draft.

962,910. APPARATUS FOR THE CONTINUOUS MANUFACTURE OF FILAMENTS. Georges Michaud and Eugene Delasson, Montreuil, Seine, France. Original application filed Oct. 30, 1907. Divided and this application filed Sept. 30, 1908. Apparatus for the manufacture of filaments from oxides of the rare metals, comprises a press adapted to receive agglomerated raw material, a nozzle through which the material is caused to pass by the press for forming a filament, an electric furnace having an infusible tube through which the filament passes and electric carbons for producing an arc for heating the tube, and a knife arranged at the extremity of the infusible tube for severing the filament as it leaves the tube.

962,921. TERMINAL FOR ELECTRIC CONDUCTORS. Eberhard Schneider, New York, N. Y. Filed Feb. 2, 1909. A lug or terminal for electrical conductors comprises a body portion, and a pair of wings extending laterally from the body portion on opposite sides thereof, one of the wings having a notch to receive the conductor formed in one of its side margins.

962,923. PENDENT ELECTRIC SWITCH. Frank E. Seeley, Bridgeport, Conn., assignor to The Perkins Electric Switch Manufacturing Company, Bridgeport, Conn. Filed Sept. 4, 1908. A pendent electric switch comprises an inverted cup of insulating material, a push button switch-mechanism therein, embracing a push button at the bottom, a ratchet wheel and contracts, and a frame in which the mechanism is wholly mounted, the frame having a terminal plate passing through the top of the inverted cup.

962,958. SOLENOID OPERATING MECHANISM. Edward M. Hewlett, Schenectady, N. Y., assignor to General Electric Company. Filed Nov. 17, 1906. An electric switch.

962,966. ELECTRIC RAILROAD BONDING SYSTEM. George H. Lindsey, Austen, W. Va. Filed May 26, 1909. The device comprises splice bar having a longitudinal groove extending between two bolt openings, a U-shaped bond having its connecting member fitted in the groove, the arms of the bond being partially threaded upon their inner faces, connecting bolts having grooves to receive the arms of the bond, and nuts threaded upon the bolts and bond arms.

962,989. ELECTRICALLY-HEATED FLATIRON. George E. Stevens, Lynn, Mass., assignor to General Electric Company. Filed May 8, 1909. An electric flatiron comprises an electrically heated body provided with terminal pins, a switch secured to the terminal pins, a handle for the iron; and a member clamped to the handle and arranged to be engaged by the hand to operate the switch.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired July 4, 1910:

500,545. TELEPHONE SYSTEM. George L. Anders, London, Eng.

500,563. SIGNALING SYSTEM. William E. Decrow, Boston, Mass.

500,601. SAFETY CUT-OUT. Olof Offrell, Middletown, Conn.

500,604. METHOD OF AND APPARATUS FOR SEPARATING ORES. Clarence Q. Payne, Stamford, Conn.

500,605. MAGNETIC ORE-SEPARATOR. Clarence Q. Payne, Stamford, Conn.

500,606. DEVICE FOR AND METHOD OF ADJUSTING AND EQUALIZING THE MAGNETIC DENSITY IN THE POLE-PIECES OF MAGETIC SEPARATORS. Clarence Q. Payne, Stamford, Conn.

500,614. BRUSH-HOLDER FOR DYNAMO-ELECTRIC MACHINES. Henry G. Reist, Lynn, Mass.

500,629. ELECTRIC SWITCH. Elihu Thomson, Lynn, Mass.

500,630. METHOD OF AND MEANS FOR PRODUCING ALTERNATING CURRENTS. Elihu Thomson, Swampscott, Mass.

500,631. RHEOSTAT. Elihu Thomson, Swampscott, Mass.

500,644. ELECTRIC IGNITOR. William F. West, New York, N. Y.

500,657. ELECTRIC-ARC LAMP. Rudolph M. Hunter, Philadelphia, Pa.

500,663. ELECTRIC MOTOR. John MacHaffie, Schenectady, N. Y.

500,668. RAILWAY SIGNAL APPARATUS. Joseph C. G. Mugnier, Paris, France.

500,670 and 500,671. INCANDESCENT ELECTRIC LAMP. William E. Mickerson, Cambridge, Mass.

500,681. ELECTRIC SOLDERING-IRON AND HEATER. August Tinnerholm, Schenectady, N. Y.

500,726. LIGHTNING-ARRESTER. Charles S. Van Nuis, New Brunswick, N. J.

500,822. ELECTRIC HOSE-COUPLING. Joseph B. Strauss, Cincinnati, Ohio.

500,827. RAILWAY SIGNAL SYSTEM. George L. Thomas, Brooklyn, N. Y.

500,829. ELECTRIC-ARC LAMP. William A. Turbayne, Detroit, Mich.

500,841. INCANDESCENT LAMP GLOBE. Thomas B. Atterbury, Pittsburg, Pa.

500,849. ELECTRIC INCANDESCENT LAMP. Henry D. Burnett, Lynn and Samuel E. Doane, Swampscott, Mass.

500,851. ELECTRIC LOCOMOTIVE. Lawrence W. Case, Highland Park, Conn.

500,918. ELECTRIC SWITCH. George E. Linton, Worcester, Mass.

500,937. CONDUIT RAILWAY INSULATOR. George E. Noyes, Washington Grove, Md.

500,943. ELECTRIC-RAILWAY SYSTEM. Frederick S. Perrin, Lynn, Mass.

500,973. ELECTRIC WELDING MACHINE. Maximillian M. Suppes, Johnstown, Pa.

500,978. SECONDARY ELECTRIC BATTERY. Charles Theryc, and Alfred Oblasser, Paris, France.

501,000. METER FOR ALTERNATING PULSATING OR INTERMITTENT ELECTRIC CURRENTS. Thomas Duncan, Fort Wayne, Ind.

501,009. OVERHEAD ELECTRIC RAILWAY. John C. Henry, Westfield, N. J.